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Journal of the Council for Scientific and Industrial Research.

Vol. 16. FEBRUARY, 1943. No. 1.

The Anthelmintic Efficiency of Phenothiazine Against Immature *Trichostrongylus* spp. in Sheep.

*By H. McL. Gordon, B.V.Sc.**

Summary.

Trials with a group of five-months-old sheep showed that phenothiazine is considerably less efficient in killing immature *Trichostrongylus* spp. than in killing the mature parasites.

Introduction.

It has been found (Gordon, 1939A) that, in general, anthelmintics are less effective against immature than against mature *Haemonchus contortus*. This finding is of great significance in controlling outbreaks of helminthiasis where reinfestation may be almost continuous and where, at the time of any particular treatment, worms of various ages will be present.

It is important to know whether infestations with immature *Trichostrongylus* spp. show a similar resistance to anthelmintics. It has been shown (Gordon, 1939B) that phenothiazine is very effective against mature *Trichostrongylus* spp., and that it is highly efficient against immature *H. contortus* (Gordon, 1940).

Experimental.

Thirty worm-free sheep, about 5 months old and weighing about 30 lb., were dosed with 24,000 larvae each. The larvae were of the species of the genus *Trichostrongylus* which inhabit the duodenum, and were chiefly *T. colubriformis*. Ten days later, a group (A) of 10 of these sheep was treated with 10 g. phenothiazine, five by injection into the abomasum, five by injection into the rumen.

Five days later, that is, 15 days after the infective larvae were administered, a further group (B) of 10 sheep was treated with 10 g. phenothiazine, six by injection into the abomasum, and four by injection into the rumen.

The remaining 10 sheep, group (C), served as controls. The dose rate used was based on previous trials, that is, 0·6 g. per Kg. body weight. Egg counts were begun 21 days after the dose of larvae and were repeated at intervals, usually daily, until the 35th day.

* An officer of the Council's McMaster Animal Health Laboratory, Sydney.

Table 1.—Egg Counts (Eggs per gramme of Faeces).

Group A.—Sheep treated when worms were 10 days old.

Days after infective larvae given.	Group A_1 (abomasal injection).					Group A_2 (rumenal injection).				
	Sheep Nos.					Sheep Nos.				
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
21 ..	4,200	1,200	Died	1,000	1,200	3,800	2,000	3,200	600	1,000
22 ..	2,200	2,200	..	1,000	2,200	3,400	1,800	6,200	4,800	..
24 ..	4,400	3,200	..	400	3,200	4,200	800	Died	2,000	..
25 ..	800	200	..	400	800	2,200	600	..	..	200
26 ..	2,800	800	..	2,200	800	1,600	1,000	..	2,600	400
28 ..	800	1,000	..	800	1,800	2,800	800	..	2,600	1,600
29 ..	..	2,600	..	3,800	1,200	3,200	3,600	..	2,000	1,000
30 ..	1,000	1,800	..	400	2,000	2,200	1,400	..	3,000	1,800
31 ..	150	2,000	..	1,400	1,000	2,800	2,200	..	600	1,600
32 ..	900	4,000	..	1,800	..	200	2,700	..	..	600
33 ..	1,200	2,400	..	2,800	1,000	3,400	1,400	..	2,000	1,000
35 ..	1,600	1,800	..	600	1,200	1,600	400	..	2,200	600

Group B.—Sheep treated when worms were 15 days old.

Days after infective larvae given.	Group B_1 (abomasal injection).					Group B_2 (rumenal injection).				
	Sheep Nos.					Sheep Nos.				
	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
21 ..	800	600	1,000	1,200	1,200	500	1,800	1,800	1,200	400
22 ..	1,600	1,600	2,600	2,600	3,400	400	400	2,400	600	1,200
24 ..	1,600	800	4,600	3,200	1,400	600	1,400	1,800	1,600	1,400
25 ..	2,600	400	4,400	1,000	1,600	600	800	800	3,200	..
26 ..	3,400	1,000	3,400	3,800	2,000	1,200	3,400	4,600	3,600	2,000
28 ..	1,800	400	4,400	600	2,400	200	1,400	1,400	1,400	200
29 ..	15,000	2,200	6,400	1,400	1,000	800	1,800	2,000	1,600	1,600
30 ..	6,000	1,000	1,800	2,000	2,200	200	1,000	2,400	2,000	1,000
31 ..	5,000	2,200	1,000	800	1,800	600	200	4,600	1,800	3,000
32 ..	3,300	600	1,400	2,400	2,000	800	1,000	600	800	2,400
33 ..	6,400	600	3,800	1,800	1,400	400	1,200	1,400	..	4,200
35 ..	2,400	800	3,000	2,400	2,000	1,000	1,000	800	800	6,900

Group C.—Untreated Controls.

Days after infective larvae given.	Sheep Nos.									
	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.
21 ..	4,800	1,400	2,600	1,800	3,400	1,500	800	2,800	..	6,000
22 ..	7,000	1,200	1,400	1,200	6,000	5,200	..	2,200	4,200	4,200
24 ..	4,400	400	2,600	4,000	4,600	2,800	..	1,400	..	3,000
25 ..	2,000	400	1,200	2,800	2,800	..	5,600	200	..	1,000
26 ..	400	1,000	2,000	4,200	2,200	7,000	2,400	2,800	Died	6,200
28 ..	1,200	1,800	6,000	600	2,000	17,000	4,400	1,200	..	8,100
29 ..	400	5,000	2,000	7,200	3,000	93,000	13,000	3,400	..	3,400
30 ..	1,800	4,800	1,800	10,800	3,000	22,000	6,000	2,000	..	7,600
31 ..	1,200	1,800	3,400	2,800	2,600	10,000	..	2,800	..	6,200
32 ..	1,000	2,100	2,000	Died	2,700	9,600	2,700	2,200	..	5,100
33 ..	2,200	3,900	1,800	..	2,200	27,900	Died	2,800	..	15,200
35 ..	800	5,000	2,800	..	5,400	56,400	..	4,200	..	9,400

Results.

The results of the egg counts are shown in Table 1.

Statistical Examination of Results.

An analysis was carried out on the egg counts over the period of the trial. In the control group, sheep No. 26 had a mean egg count of almost seven times the mean of the rest of the group. This sheep was excluded from the analysis as its inclusion made the variance within the group too large and hence it was not so easy to demonstrate significance between the groups.

The mean egg count for the controls (about 3,600 eggs per gramme) was significantly higher than those of the two treated groups. The mean egg counts for these groups were 1,700 and 1,900 eggs per gramme, respectively, for sheep treated 10 and 15 days after infestation began.

There was no significant difference between groups treated at these intervals and there was no significant difference between egg counts for sheep in which the drug was injected into the rumen and those in which it was injected into the abomasum.

Five sheep died before the completion of the trial. A count was made of the number of *Trichostrongylus* spp. present at post-mortem examination and the results are recorded below. It is of no value to attempt a comparison of the numbers found in sheep from different groups because it has been found that sheep which succumb to trichostrongylosis usually pass out many of the worms in the last few days before death.

The number of worms found were—

Group A.—	No. 3 died on 21st day ..	6,000	*Trichostrongylus* spp.
	No. 8 died on 24th day ..	9,000	,,
Group C.—	No. 27 died on 33rd day ..	4,800	,,
	No. 29 died on 26th day ..	10,000	,,
	No. 24 died on 32nd day ..	6,400	,,

Discussion.

The relatively low degree of anthelmintic efficiency of phenothiazine against immature *Trichostrongylus* spp. 10 and 15 days old is of special importance in relation to the control of outbreaks of disease caused by these parasites. If treatment is carried out during the active stage of the outbreak when daily reinfestation is taking place, a large proportion of the worms 15 days old and younger will survive, and unless treatment is repeated will grow to maturity and begin to produce eggs further to contaminate pastures. In addition, these worms will contribute to the pathogenesis of the disease.

It is clear that once an outbreak has developed, a single treatment, even with phenothiazine, will be ineffective in bringing about a resolution. Repeated treatments are essential throughout the period of an outbreak when continuous reinfestatoin is likely, e.g., in dull, showery, cool weather. Intervals of 10 to 15 days between treatments should not be exceeded.

The efficiency of other anthelmintics against immature *Trichostrongylus* spp. is not known, but in view of the considerably lower degree of efficiency of many anthelmintics, compared with phenothiazine, against the adult parasites, it seems reasonable to assume that these drugs will at best be inferior to phenothiazine.

Conclusions.

1. Phenothiazine is considerably less efficient in killing immature *Trichostrongylus* spp. than in killing the mature parasites.

2. Under active outbreak conditions where continuous reinfestation is taking place, treatments must be repeated if a rapid resolution of the outbreak is to be achieved.

Acknowledgment.

Miss M. Hornby is thanked for carrying out the statistical examination of the results.

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Technique for Harvesting Seed of *Paspalum scrobiculatum.*

By T. B. Paltridge, B.Sc. and J. E. Coaldrake, Q.Dip.Agr.†*

Summary.

A method is described for collecting the seed of *Paspalum scrobiculatum* from the ground with a vacuum seed-collecting machine.

1. Introduction.

The grass *Paspalum scrobiculatum* (L.) var. *commersonii* (Stapf.) is one of the most promising being studied by the Plant Introduction Section, at Lawes, Queensland,‡ and, because adequate supplies of seed, available at reasonable cost, are a fundamental necessity for economic utilization of any pasture plant, the development of suitable seed production technique for this species has been a major consideration. *Paspalum scrobiculatum* is a prolific seeder, but in the early stages of our investigations difficulty was experienced in harvesting, because the inflorescences and individual spikes mature in basipetal succession and ripening may extend over three or four months. Harvesting by usual methods proved very inefficient, both because a large proportion of immature fruits and flowers was collected and because of the loss of many mature fruits, which fall as soon as they are ripe. Difficulties of seed harvesting, in consequence of these characteristics, have now been overcome by planting in rows and allowing the seed to fall, and later collecting this from the ground with a vacuum seed-collecting machine. The present paper gives a detailed account of the technique evolved and some discussion of economic aspects. It would appear that seed production of this grass could be, of itself, a profitable venture.

2. Establishment and Care of Seed Production Areas.

It is not possible at present to say what would be the life of parent plants on a seed production area. However, at Lawes, five-year-old plants are still yielding well. It seems probable that, with proper care, a stand should be fully productive for at least a decade.

For seed production clean, weed-free land is an obvious necessity, if the product is to meet seed certification requirements; and with *Paspalum scrobiculatum* initially clean fallow is more than usually important, because the grass is so palatable that grazing to control weeds is liable to be very unsuccessful. On such an area seed should be sown at a depth of 1½ inches, in rows 4 feet apart, and at 2 lb. per acre. Planting can be done either with a maize planter (using the sorghum plates) or with a standard wheat drill.§ It should be commenced after the first good spring rains; i.e., after any precipitation

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† Assistant, Grade II., Division of Plant Industry.

‡ "Preliminary Selection and Evaluation of Pasture Species at Lawes (Queensland)." Coun. Sci. Ind. Res. (Aust.), Pamph. No. 114. Melb. 1942.

§ With some wheat drills the usual grain box can be used; in others it will be found necessary to use the lucerne box. Again, in some makes of implement it may be necessary to feed two lucerne tubes into each planting drill.

exceeding 2 or 3 inches in October, November, or December. Late planting, during January or February, will give excellent stands, but is not recommended. However, even with late planting it may be possible to harvest very good returns during the first year.

During early growth frequent and thorough inter-row cultivation is desirable. Both disc and tyne cultivators should be used, according to the nature of the weed growth and the condition of the soil. On small areas, an 18 or 20 inch rotary hoe would be very efficient. Some hand weeding or chipping may be necessary in the rows. Under normal seasonal conditions the plants will reach adult dimensions within three months and, in this time, lateral culms will spread to cover completely and shade the 4-ft. inter-row spaces. As this growth proceeds cultivation should be restricted and no further cultivation attempted in a mature stand until the harvest is completed.

Fruiting commences normally in January and may continue well into April. Harvesting should not be commenced until 90 per cent. of spikes have cast their seed. After harvesting the parent plants can be grazed off.* Thereafter the area should be mown and raked off, or burned, and inter-row cultivation, weeding, &c., recommenced in preparation for the next season's harvest.

3. Harvesting.

In harvesting, the first operation is to "uncover" every second inter-row space, by folding back the culms of parents plants with a hay fork. The space so cleared should then be lightly raked† to remove fallen leaves and other debris. When all seed has been collected from these inter-row spaces, the foliar bulk covering the intervening row-spaces can be folded back on to the areas already harvested and the remainder of the crop collected.

Machinery designed for collecting seed from the ground consists essentially of a 12-inch blower, which provides the necessary suction. This is mounted on a portable frame and driven by a small engine ($2\frac{1}{2}$ h.p.). The inlet to the blower is bifurcated and to each branch there is attached about 9 feet of 2-inch flexible metal hose, each hose terminating in a 3-ft. length of rigid metal piping which has a "fish-tail" nozzle. These "fish-tails" have an inturned lip, 3/16 in. wide, and an opening, 6 in. long by $\frac{3}{4}$ in. wide. The output from the blower is directed into chambers arranged to allow free exit for the draught and the collection, by gravity, of seed and debris.

Our original machine, built by P. Jahn, of Glenore Grove, incorporated an old motor cycle engine. The suction hoses were attached direct to the blower and the output fed into a long trough suspended below the framework. The top of this trough was open to allow free exit of the draught (see Plate 1). An improved model, built by Becker's Motors, of Toowoomba, incorporates a "Southern Cross" $2\frac{1}{2}$ h.p., water-cooled engine, and the frame is supported on rubber-tyred disc wheels‡

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* This should provide approximately 900 sheep-days per acre, or equivalent grazing.

† Light raking, with hand rakes, has proved a time-saving practice, because it removes fallen leaves, &c., that tend to choke the "fish-tails" of the harvesting machine.

‡ Disc wheels are preferred, because spokes tend to collect straw, &c., and to become tangled in the grass.

(see Plate 2). The suction hoses are attached to the cross arms of a "T-piece," fixed at a point 4 feet above the ground, the "stem" of the "T" being fed to the fan inlet through a 3-inch stout rubber hose. This allows more freedom of movement and less drag on the operators.

The output from the blower is fed tangentially into a small "cyclone chamber" with screened lateral openings, through which air and much fine dust escape. This chamber has a funnel-shaped bottom by means of which seed, &c., is gravity-fed to a small rotary grader. The walls of the grader cylinder are made of perforated zinc sheeting (1/16-in. holes) and serve to sieve off a very large bulk of fine dirt, which is returned direct to the ground. The seed, &c., issuing from the end of the drum, is led into a suitably arranged bin behind the grader drum.

The blower, which is 12 inches in diameter by 4 inches across, has a six-bladed rotor, fitting loosely inside the housing. Inlet and outlet tubes are both 3 inches in diameter. The rotor is driven at approximately 3,000 revolutions per minute. The grader drum is driven by a friction shaft, appressed to rubber tyres which are mounted at either end. It revolves at about 15 revolutions per minute.

In early experiments attempts were made to use large "fish-tails" suspended below the undercarriage,* but it was found that small irregularities of the ground surface rendered suction very inefficient. Moreover, the greater bulk of seed tends to fall and to accumulate closely round the bases of parent plants, whence it cannot be collected by such a semi-fixed "fish-tail." The hand-operated units, eventually adopted, proved most efficient. They are used much as one uses a household vacuum cleaner.† Being individually manipulated, they can be made to collect seed right at the bases of large plants and from any depression wherein a greater bulk of seed may have collected.

Frequently it happens that seed is lightly covered with a layer of loose soil and it has been our general practice to remove, by suction, a quarter inch of soil, debris, and seed from the whole of any inter-row space (see Plate 3, Fig. 1). Much of the soil so collected is returned through the pores of the grader drum and the bulk material retained can subsequently be cleaned and prepared for marketing.

As harvesting must of necessity be confined within a period of about ten weeks, during May, June, and July, or June, July, and August, any machine of this type has a limited capacity. Two men operating our machine can harvest not more than an acre in eight and a half days; however, the capacity of the blower unit, &c., is ample for operating three hoses and it is suggested that a more economic unit would be a similar machine incorporating three hoses. Three men operating such a machine could harvest an acre in 5·6 days, i.e., one working week.

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* Machines of this type, designed for harvesting seed of buffalo grass, are described in *Agricultural Engineering*, May, 1936.

† In correspondence, Mr. J. E. Smith, Nursery Manager, U.S. Field Station, Woodward, Oklahoma, reports similar experience with vacuum seed harvesting machinery developed in Texas. Here again, small machines, using hand-operated "fish-tails" proved most efficient. Used for harvesting buffalo grass seed, these machines were not very successful, because the yields from open prairie were too small. This is a proposition differing appreciably from harvesting plots sown and maintained especially for seed production. Moreover, *Paspalum scrobiculatum* fruits prolifically and the comparatively large, rounded seeds are well suited to vacuum harvesting technique.

The annual capacity of such a machine, therefore, would be 10 acres. For larger areas it is likely that a number of similar units would be more efficient than any larger machine.

4. Seed Cleaning.

The bulk of material collected by this machine is considerable, approximately 96 bushels per acre, but it can be considerably reduced before transportation to seed merchants for cleaning. At Lawes, this preliminary cleaning is effected in a small rotary seed grader, suitably mounted on a steel framework (see Plate 3, Fig. 2). The drum of this grader is 4 feet long and 10 inches in diameter and is divided into two sections. The walls of the first section are of perforated zinc sheeting (1/16-in. holes) and those of the second section of stout wire gauze (⅛-in. holes); it revolves at about 15 r.p.m. Appropriate shoots for "feeding" and for directing the three separate fractions are attached. The unit was built by Beckers' Motors, of Toowoomba. A similar unit could be incorporated in the harvesting machine itself; thereby eliminating second handling.

After harvesting and during subsequent handling of bulk material, many dirt particles tend to break up and these, in the form of fine dirt, are sieved off in the first section of the grader. Seed and debris of comparable size pass through the walls of the second section and are collected in trays placed below. Sticks, straw, and large lumps of dirt, &c., are passed through the end of the drum.

Material given preliminary cleaning in this machine has been further treated by Messrs. Annand, Robinson and Co., Seed Merchants, of Toowoomba. It was fed first into a Robinson "Oat Clipper," in which much extraneous material was broken up and removed, and then into standard winnowing machinery. The fractions removed during this treatment and the preliminary cleaning at Lawes are shown in Plate 4. The gross return from a half-acre plot, harvested at Lawes in July, 1942, was 200 lb. clean seed.

5. Economic Considerations.

Costing for seed production is a matter of considerable difficulty and estimates are subject to variation in accordance with equipment and labour available on a given farm and the possibilities of working a seed production project in with other activities. However, some estimate of the cost of production is considered desirable if we are to illustrate practicability of the technique developed.

Figures given in the Appendix are based on a hypothetical 10-acre block and very liberal allowances have been made in regard to all items of expenditure. These include overhead charges on a small tractor and necessary ploughing, planting, and cultivating attachments; land rental, assuming the land to be out of other use for twelve months during the year of establishment; and eight cultivations per annum.

On the basis of these estimates the cost of production does not appear to be excessive. The market price of the seed, of course, cannot be laid down but, as recommended planting rates for pasture do not exceed 2 lb. per acre, this could be fairly high without prejudicing sales. If the seed were to be sold at 5s. per pound the cost of planting, per acre, would be little more than half that for planting lucerne at 8 lb. per acre, at prices ruling on the market to-day. At 5s. per pound, returns to the seed grower would be of the order of £50 per acre.

Appendix.

Estimated costs for Seed Production on a Ten-acre Block in the Lockyer Valley, Queensland.

A. *Cost of Establishment.*

Land rental (4 per cent. on 10 acres at £25 per acre —1 year)	£10	0	0
Preparatory cultivation—			
Two ploughings (4 acres per day)	11	0	0
One discing (15 acres per day)	1	10	0
Three harrowings (30 acres per day) .. .	2	6	0
Planting (30 acres per day)	0	15	4
Seed (20 lb. at 5s.)	5	0	0
Subsequent cultivations (8 necessary)	6	2	8
	£38	14	0

B. *Annual Expenditure.*

Cost of Establishment (extended over 10 years) ..				3	17	5
Land rental				10	0	0
Cultivations (8 necessary) (30 acres per day) ..				6	2	8
Annual depreciation on harvesting machinery (based on machine incorporating 3 hoses and improved grader; to complete harvesting and preliminary cleaning in one operation. Cost £100. Life 7 years)				14	5	8
Harvesting (1 acre per week)—						
1. Opening rows and harvesting (3 men, 5½ days)	£14	2	0			
2. Petrol (11 gallons at 3s.) ..	1	13	0			
3. Oil (1 pint)	0	1	6			
4. Bags (at 1s. each)	1	12	0			
Cost per acre ..	£17	8	6			
				174	5	0
Seed cleaning (at 30s. per 100 lb. clean seed) ..				45	0	0
				£253	10	9

C. *Estimated Yield for* 10 *acres* = 3,000 lb. seed.

Cost of production is therefore 1s. 8¼d. per lb.

N.B.—Costs for ploughing, cultivation, &c., based on use of "Farmall" tractor and necessary attachments; cost £400; life 10 years. It is assumed such tractor and implements would be used for other farm operations. Depreciation charges, therefore, included only in respect to time during which equipment will be used for this work. Running costs, per tractor-day, as follows:—

1. Fuel (8 gallons)	£0	16	0
2. Oil and petrol	0	5	0
3. Wear, depreciation, and replacements for tractor and implements	0	5	0
4. Wages	1	0	0
	£2	6	0 per day.

The Inheritance of Pigmented Wool.

*By R. B. Kelley, D.V.Sc.**

An earlier note in this *Journal* (**15**: 1) suggested that, when pigmented sheep are defined as those having obviously large areas of pigmented wool, and white-wooled sheep as those which have no obviously large patches of pigmented wool, then pigmentation is a recessive condition. One hundred and three white-wooled but no pigmented lambs were the progeny of white-wooled and pigmented parents reciprocally mated.

The back-cross (white sheep, progeny of white-wooled and pigmented parents, mated with pigmented sheep) was reported to have given 37 white-wooled, and 46 pigmented, lambs.

Results have been secured this season from a further and final mating in the series. White sheep, progeny of white-wooled and pigmented parents reciprocally arranged, were themselves mated reciprocally. The F_2 generation was 21 white and 6 pigmented lambs.

The second and third results, given above, were tested for agreement with the hypotheses that the characters were segregating in the ratios 1:1 and 3:1 respectively. The corresponding values of χ^2 were 0·98 ($0{\cdot}50 > P > 0{\cdot}30$) and 0·11 ($0{\cdot}80 > P > 0{\cdot}70$). The observed segregations can thus be accepted as conforming with those from a back-cross and an F_2 population of mono-hybrids.

It is suggested that the white-wooled condition is due to the action of a dominant gene which inhibits pigmentation.

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* Officer-in-Charge, F. D. McMaster Field Station, Badgery's Creek, New South Wales.

The Recovery of the Glucoside Aesculin from the Australian Native Plant *Bursaria spinosa.*

*By A. T. Dick, M.Sc., A.A.C.I.**

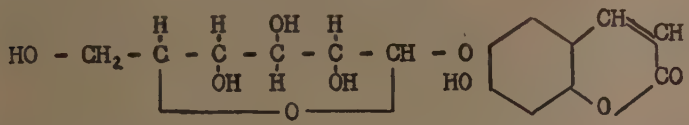
Summary.

Yields of 4 to 5 per cent. of aesculin have been obtained from the air-dried leaves of *Bursaria spinosa* by extraction with water. Its subsequent purification and identification are described.

1. Introduction.

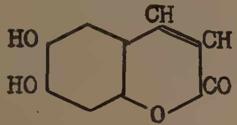
Many bacteria can be identified by their ability to split certain sugars, alcohols, and glucosides. The bacteria are grown in nutrient media to which the fermentable substance has been added and the ability of the organism to break down the test substance is usually recognized by the end products formed.

One of these test substances is aesculin (6–β–glucosidoxy–7–hydroxycoumarin) which has the formula:—



This compound may be hydrolysed by the enzymes of some bacteria into glucose and aesculetin.

Aesculetin is the dihydroxycoumarin,



and hydrolysis of aesculin by bacteria is recognized by the greenish-black pigment which aesculetin produces with ferric salts. This is the main use of aesculin in a bacteriological laboratory. It finds several medicinal and commercial uses from its property of absorbing ultra-violet light. For example, it is used in preparations for prolonging the effect of heliotherapy, in the cosmetics industry as the active ingredient of sunburn creams, in ultra-violet light filters, and in rubber compositions.

2. Sources of Aesculin.

The most common commercial source of the glucoside is the inner bark of the horse-chestnut tree (*Aesculus hippocastanum*) (Rochleder and Schwartz, 1853). According to Dieterle and Dorner (1937), yields of 0·5 per cent. of aesculin have been obtained from the bark of the hawthorn (*Crataegus oxyacantha* L.).

* An officer of the Division of Animal Health and Nutrition.

When it became necessary to find a local source of supply of aesculin for bacteriological purposes, it was pointed out by Dr. L. B. Bull, Chief of this Division, that a cold-water infusion of the leaves of Bursaria has a blue fluorescence very similar to that of an aqueous solution of aesculin. It was, therefore, decided to determine the nature of the fluorescent substance. This has now been shown to be aesculin.

3. Description of *Bursaria spinosa*.

Ewart (1930) describes Bursaria as: "An Australian genus of one species, with small white flowers, usually small entire leaves and often more or less thorny. Sepals small, free, deciduous. Petals narrow. Ovary incompletely 2-chambered, forming a compressed, capsular purse-like fruit, with 1 or 2 seeds in each chamber.

"*B. spinosa Cav., Sweet Bursaria.*

A shrub, 3 to 12 feet high, sometimes a small tree growing to a height of 20 to 40 feet and a diameter of 1 to 1½ ft., with white or cream flowers. It extends from Queensland to Wilson's Promontory, and is represented in different parts by various forms and varieties. It is one of the most polymorphic of Australian plants, varying mainly in size and shape of the leaves, in the presence or absence of spines and in the habit. It is easily recognized by the white, sweet smelling flowers, and the abundant small, brown, purse-like fruits. The flowers are 5-partite and are usually very numerous, in a broad pyramidal terminal panicle, on short stalks. The bracts are minute and soon fall off. The small sepals fall long before the petals open. The petals are narrow, and about ⅛ inch long. There are 5 stamens and the single ovary forms a flat bilobed capsule about ⅓ inch long.

"Widely spread in Victoria on loamy soils, stony hills and river banks, and near Melbourne on the basalt, silurian and red sand areas. . . . Also throughout Australia. Flowering December and January, sometimes as late as March."

The accompanying photographs should assist in the identification of the plant. (Plates 5 and 6.)

The present samples were collected in the Eltham district in August.

4. Extraction of Aesculin.

Branches are cut and allowed to dry for about ten days. If these are then shaken and rubbed together nearly all the leaves fall off and are collected.

For extraction, one gallon of water is added per pound of leaves and brought to the boil; boiling is continued for about 15 minutes and the extract strained through muslin. The leaves may then be extracted again with water to increase the yield. While the extract is still hot, one-tenth of its volume of saturated normal lead acetate is added to precipitate impurities and the mixture is allowed to cool. The precipitate is filtered off and the excess lead is precipitated from the filtrate by saturation with hydrogen sulphide, and again filtered. The precipitate is washed with hot water and the washings added to the filtrate, which is evaporated to about one-fifth of its volume. The solution is then allowed to stand for several days for the complete crystallization of the aesculin.

As the solubility is only 0·16 per cent. in cold and 8 per cent. in hot water, the aesculin is purified by several recrystallisations from water, boiling with charcoal if necessary. The yield is 4 to 5 per cent.

As an alternative method, which avoids the saturation of large volumes of solution with hydrogen sulphide and the evaporation of large quantities of water, the aesculin may be adsorbed on basic lead acetate and eluted from the precipitate with carbon dioxide gas. For this purpose, the filtrate from the normal lead acetate precipitation is made alkaline with one-twentieth of its volume of 0·880 ammonia and the precipitate collected by filtering or centrifuging. This basic lead acetate precipitate is then resuspended in a small volume of water and carbon dioxide gas is passed in until it is completely saturated. When the suspension is filtered, most of the aesculin is contained in the filtrate; any still remaining on the precipitate can be recovered by resuspending it in water, resaturating with carbon dioxide, and again filtering. The combined filtrates are then evaporated to small volume and the aesculin allowed to crystallise as before.

5. Distribution in the Plant.

Examinations have not been made throughout the year, but in the spring months when our samples were collected, nearly all the aesculin appears in the leaves.

None could be recovered from the inner or outer bark from the main trunks of the larger bushes. When the fine twigs and branches were ground up and extracted, aesculin could be detected in the extract but the quantity was very small.

6. Identification of the Product.

The following tests for aesculin were given by the product obtained:—

(*a*) The aqueous solution fluoresces blue in daylight; the intensity is increased in ammoniacal solution and reduced in acid. In ultra-violet light, the blue fluorescence is very intense.

(*b*) A yellow solution is produced on shaking with a little nitric acid. The addition of ammonia changes the colour to a deep blood-red. (Sonnenschein, 1876.)

(*c*) The melting point when heated rapidly, after drying in a vacuum desiccator over sulphuric acid, is 202°–204° C.

(*d*) It is hydrolysed by boiling with normal sulphuric acid. When neutralized and filtered the hydrolysate gives glycosazone on heating with phenyl-hydrazine and sodium acetate.

For a quantitative hydrolysis 3·0 g. of the product were boiled under a reflux condenser with 100 ml. of normal sulphuric acid for 2 hours. On standing in the cold overnight, needle-like crystals separated out and were filtered off and washed with cold water. The crystals were dried in a vacuum desiccator over sulphuric acid and weighed. (Yield, 1·35 g.) The uncorrected melting point of this compound was 260°C. with decomposition. With ferric salts it gave a deep blue-green colour, which, in concentrated solution appeared almost black. These properties correspond with those of aesculetin.

The filtrate from the hydrolysed aesculin was neutralized with caustic soda and the reducing sugars determined by a modified Hagedorn and Jensen method (Hanes, 1929). There were 1·28 g. of reducing sugars calculated as glucose. Thus the ratio of aesculetin to glucose in the hydrolysed product was 1·05 : 1·00. The theoretical ratio in aesculin is 0·99 : 1·00.

(*e*) The specific rotation in pyridine is $[\alpha]_D^{22}$: $-38°\cdot6$ ($p = 1\cdot5$). Seka and Kallir (1931) give the figure $-38°\cdot5$ for aesculin under the same conditions.

(*f*) The product was finally tested in the usual culture media and sown with *Streptococcus faecalis*. The results were identical with those in a parallel series containing aesculin.

7. Conclusions.

The leaves of the Australian native plant *Bursaria spinosa* yield 4 to 5 per cent. of aesculin. This is a possible source of local supply of this valuable glucoside for bacteriological and other purposes.

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Tests for Quality in Egg Pulp.

1. A Preliminary Note on the Application of the Reductase Test Using Resazurin as the Indicator.

By W. J. Scott, B.Agr.Sc. and J. M. Gillespie, M.Sc.**

Summary.

The possible application of the reductase test for the rapid judgment of egg pulp quality has been examined. In the egg pulps so far studied the spoilage organisms, mainly of the *Pseudomonas* group, have low optimal temperatures and weak reducing powers.

A method is described for carrying out reductase tests on egg pulp, using resazurin as the indicator, at 30°C.

The results show that the time for reduction to the pink colour affords a reliable prediction of the bacterial content of the pulp.

1. Introduction.

The recent extensive development of egg pulping and egg drying in Australia has raised the problem of the satisfactory measurement of quality in these products.

Egg pulp is an extremely perishable material which requires great care to ensure a product of high quality. The level of quality is largely determined by the extent of bacterial contamination, the bacterial population of a sample of egg pulp being at once a measure of its keeping quality and of its previous history.

Variations in the bacterial population of egg pulp samples are due mainly to the quality of the eggs used, the standard of hygienic control during breaking operations, and to conditions during subsequent handling and storage. Each of the above factors may have a profound effect on the bacterial contents of the pulp, and, moreover, some samples containing very high populations (10^8 per ml.) may lack obvious signs of spoilage. It is important therefore that simple and reliable methods of judging the bacteriological quality of egg pulp be available. A method commonly used is the plate count, but the time and degree of skill required are disadvantages limiting its application in industry where rapid judgment on a large number of samples may be required.

Similar problems in the judgment of milk quality have been met by the adoption of reductase tests. These are now in universal use, and it was considered that similar tests might be applied to the grading of egg pulp. The following note describes some observations on samples of commercial pulp prepared in Victoria during 1942.

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* An officer of the Division of Food Preservation and Transport.

2. Preliminary Experiments.

Preliminary experiments were carried out, using the modified methylene blue reductase technique of Wilson (1935). It soon became apparent that certain important modifications in this technique were necessary. The predominant organisms in the samples of pulp under study were members of the *Pseudomonas* group. These organisms have low optimal temperatures and weak reducing powers. To apply the reductase test to the estimation of a bacterial flora having these characteristics, it was desirable to lower the reduction temperature to 30°C. and to substitute a more sensitive dye in place of methylene blue.

Resazurin was then selected as an indicator more readily changed by weakly reducing organisms (Little, 1940; Johns and Howson, 1940). Further, its use for egg and meat products had been previously suggested by Proctor and Greenlie (1939).

This dye is reduced in two stages. The first stage is to a distinct and different colour, from blue to pink, and the second is from pink to colourless. In egg pulp the first stage of reduction shows a change from a greenish hue through mauve to a bright pink. This pink colour is a convenient end point as, to a considerable degree, it is not influenced by the colour of the egg pulp itself.

The first stage of the reduction of resazurin is not due to an electronic transfer, as with methylene blue, but to the loss of an oxygen atom loosely bound to the nitrogen of the phenoxazine nucleus. The change is not reversible by atmospheric oxygen and, according to Johns (1941), is largely independent of both reduction potential and oxygen content.

3. The Modified Test.

Materials and Apparatus.—The use of a standard resazurin solution is important. At present, standardization by chemical means is not practicable. For this reason material prepared by the Eastman Kodak Company was used exclusively in these experiments. The product of the National Aniline and Chemical Company is also satisfactory, but the European brands tested have not proved reliable.

A 0·05 per cent. solution in sterile distilled water is made and stored in the refrigerator. Provided that the solution is kept sterile, no significant change in strength should occur over a period of six months. As required, this stock solution is diluted tenfold with sterile distilled water. The addition of 2 ml. of the diluted solution to 10 ml. of egg pulp gives a final concentration of resazurin of approximately 1/120,000. The apparatus used is that described by Wilson (1935) with the exceptions that the bath is maintained at 30°C., and 2 ml. pipettes are used for measuring the resazurin solution.

Technique.—The samples of egg pulp are thoroughly mixed and then 10 ml. aliquots are measured into duplicate graduated test tubes. Two ml. of the diluted resazurin solution is then added by pipette and each tube fitted with a sterile rubber stopper. At least six inversions are necessary to distribute the dye evenly throughout the pulp. The tubes are then placed in the 30°C. bath and examinations made at half-hourly intervals. Reduction is recorded when duplicate tubes show a bright pink colour.

Observations.—The technique was tested on thirty samples of commercial egg pulp prepared in Victoria during 1942. Parallel determinations of the plate count per 1 ml. (P) were made, using beef extract agar plates incubated at 25°C. for three days. Fig. 1 shows the values of log P plotted against the reduction time in minutes (T), and the regression line fitted to the observed points. The regression co-efficient is highly significant, being nearly 26 times its standard deviation.

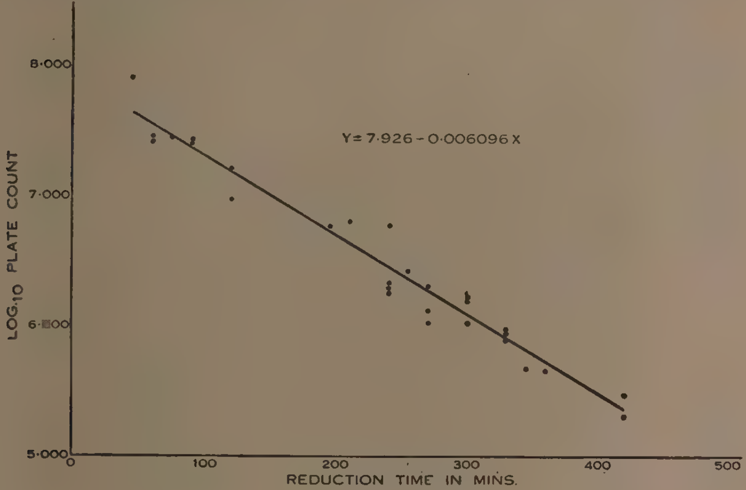

Fig. 1.

4. Discussion.

The high level of significance of the linear regression equation and the close correlation (−0·98) between the variables log P and T indicate that a measure of the reduction time affords a reliable prediction of the numbers of bacteria present in the sample. The predictions, therefore, may be applied to the bacteriological grading of egg pulp. The comparative rapidity of the test and the fact that it may be carried out reliably by persons with limited scientific training are two factors supporting its use in industry.

Early experiments using pure cultures of bacteria have amply demonstrated that the type of flora greatly influences the reduction time. As the types of spoilage organisms common in egg pulp may vary between different areas, it may be necessary to establish separate correlations for each large centre of pulp production. This question is now being investigated for other Australian centres, and the observations are being extended to cover a greater range of quality in the samples.

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The Effects of Addition of Lime and Depletion of Soil Nutrients on Take-all of Wheat.

*By H. R. Angell, O.B.E., Ph.D.**

Summary.

1. During the seasons 1938-1941, inclusive, experiments were made out of doors, in five-gallon drums of soil, to determine the effect of four soil bases on the occurrence of take-all of wheat.

2. White heads are the most outstanding symptom of the disease, but as they did not develop extensively in the experiment, four other symptoms on mature plants were used as criteria.

3. Take-all of wheat is controlled by the addition to the soil of large amounts of lime, but not by ground limestone, gypsum nor by other bases.

4. The occurrence of take-all in uninoculated drums in the second and succeeding seasons indicates that depletion of available plant food may be the main factor that predisposes plants to the disease. If no inoculum is applied at sowing time, signs of the disease may appear only when the plants are approaching maturity. No significant differences between treatments appear during the seedling stage

1. Introduction.

The influence of the chemical composition of the soil on root-rot of wheat has been observed by several workers. Machacek (7) investigated the effect of excess magnesium on *Helminthosporium sativum* P.K.B. and *Fusarium culmorum* (W.G.Sm.) Sacc., and Humphrey (3) and Evans (1) reported on alkaline spots and soils in relation to severe root-rot in fields. Moritz (10) observed that root-rot caused by *Ophiobolus graminis* Sacc. was found on podsol soils but not on the czernosem. Rosen and Elliott (13) concluded that under their conditions the disease was adequately controlled by the use of commercial fertilizer, and that lime had no effect. Garrett (2) recommended avoiding the use of lime and alkaline fertilizers. According to the report of the Waite Agricultural Institute, S.A., 1925-1932 (14), take-all in the field was controlled by the addition of superphosphate to the soil. Hynes (5), however, concluded otherwise. Millikan (8) in field trials found that the addition of zinc to some fields in Victoria increased root growth and enabled the plants to withstand the deleterious effects of root-rotting organisms.

The soils in some wheat-growing districts in Australia contain large amounts of calcium and magnesium carbonates, and salts of sodium and potassium are present in the lower horizons. The percentage of exchangeable calcium in some of these soils is, however, low and the percentages of exchangeable magnesium, sodium, and potassium are high (12). That wheat may in some years suffer more from take-all in such districts than in others with better types of soil appears to be the fairly general experience.

In an attempt to determine if the salts and exchangeable bases in soils influence the incidence of take-all, some compounds of calcium, magnesium, potassium, and sodium were added in 1938 to drums containing an alluvial soil gathered near Canberra. Crops of wheat were grown for four successive years in the soil so treated.

* Principal Pathologist, Division of Plant Industry

It is evident that under the conditions of the experiments the control of take-all obtained in some pots appears to be associated with balanced nutrition and consequent resistance of plants grown in soils to which very large amounts of hydrated lime were added.

Equally significant are the results of growing wheat for two successive years in pots that were either inoculated, or, in contrast, used as controls during the previous year. Other experiments on this subject are to be reported later.

In this paper the materials, methods, and results of an experiment that was begun in 1938 are outlined and briefly discussed.

2. Materials and Methods.

Galvanized iron vessels, 16 inches deep by 11 inches in diameter, were used in these experiments. To guard against zinc toxicity and to delay corrosion, the internal surfaces were coated with bituminous paint.

During the last week of April, 1938, excessive amounts of some compounds of calcium, magnesium, sodium, and potassium were added to soil in the drums. The drums were divided into series, each of six drums, and one of the following compounds was added to all the drums in a particular series:—

(*a*) 4 kg. hydrated lime.*

(*b*) 4 kg. ground limestone.

(*c*) 0·5 kg. calcium sulphate.

(*d*) 1·5 kg. ground magnesite.

(*e*) 6·6 gm. potassium carbonate.

(*f*) 116 gm. sodium chloride.

One gramme of superphosphate was also added to each drum at sowing time every year. Some combinations of these compounds were also tried. Because the first four compounds were only slightly soluble, they were intimately mixed with all the soil that was to be placed in each drum, the others were added in dilute solution on the surface of the soil with which the drums were previously filled.

When filling, care was taken to firm the soil thoroughly to obviate later settling to more than 1 inch below the edge of the container. By leaving only that limited space for receiving natural or artificial supplies of water, accumulation of water on the surface of the soil was seldom evident for more than a few hours after rain or heavy watering, and waterlogging was never a problem even though no provision was made for drainage.

On 5th May, 1938, twelve grains of Nabawa wheat were sown 1 inch deep in three of each series of six drums. About fifteen portions of a sterilized oats-barley mixture were placed between, and on the same level as, the seed, each portion consisting of a single grain and the adherent dead mycelium of *O. graminis*. The other three drums were similarly treated, except that viable inoculum was used. In the soil to which sodium chloride was added germination was very poor, consequently the six drums were resown on 25th May and were discarded at the end of the season.

* In this paper the words "hydrated lime" refer to commercial lime that is more or less carbonated.

During the 1938 season the concentration of some of the added compounds was evidently high enough to be very toxic to wheat. To ameliorate this condition the upper quarter of soil was removed and fresh soil substituted, every drum used in the experiment being treated similarly. One-quarter of the insoluble compounds and an undetermined portion of the soluble salts or of the compounds formed from them were thereby removed. The newly added soil was a good alluvium.

On the 3rd April, 1939, Nabawa was again sown, the previous year's procedure being followed in detail. When the grain was ripe the plants were harvested, air-dried, and weighed.

Before sowing on 2nd May, 1940, the drums were randomized in position in a bird-proof cage. In contrast with the previous year's sowings, no inoculum was added. After the seedlings were well established, all but six per drum were discarded. The plants were harvested at maturity, air-dried, weighed, the tillers counted, the condition of the roots, the average grain weight, and grade of grain from each head were estimated. Each head was threshed separately and the grain compared visually with the standards. Fourteen grades were previously decided on. They were based on the average weight per grain from selected heads. The average weight varied from less than 0·0050 g. to 0·070 g. Because none of the experimental plants that showed the usual obvious field symptoms of take-all bore grain of greater average weight than 0·0350 g. (grades 0–7), all heads that produced grain of an estimated average weight of less than this figure were considered as being affected by take-all and were so classified. If the standard was raised to grade 9, which was equivalent to an average grain weight of not more than 0·0450 g., almost equally significant results were obtained from the figures.

The roots were graded according to three standards—good, partly rotted, badly rotted—the associated numerical ratings being 1, 2, 3.

In 1941 the seed was sown on the 19th May. As in 1940 inoculum was not added. All but six seedlings per drum were later discarded. The mature plants were harvested and were subsequently treated as the others were in the previous year.

3. Results.

(*a*) *In* 1938.

Under the conditions prevailing during the season, the seedlings were not obviously affected by inoculation with *O. graminis;* by visual examination no consistent differences, except as noted in the succeeding paragraph, were detectable between the controls and the inoculated plants until near heading time.

Generally, growth was only fair; in the drums to which either sodium chloride or hydrated lime or ground calcium carbonate was added it was poor to very poor, most of the plants in the soil treated with burnt lime or ground limestone failing to mature. With the exception of these three and the potassium carbonate series, which latter was the best of all until the brairding stage, the average growth in the drums of soil to which chemical compounds were added varied but

little from that in the control soil until just before heading. A few plants in the drums to which (*a*) sodium chloride, (*b*) potassium carbonate + sodium chloride + *O. graminis,* (*c*) magnesium carbonate + sodium chloride, were added, died before the heads emerged. As was also observed in other experiments made in 1939 and 1940,* the seedlings grew best in soil to which potassium carbonate was freshly added, maintaining the lead until brairding began. The initial advantage then disappeared. By contrast, symptoms that seemed to resemble mild toxicity then ensued. Typical take-all symptoms later appeared in 18 out of 32 plants, the more nearly normal ears bearing a large number of aborted spikelets towards the tips, a condition referred to by Pittman (11) as tipped ears. No differences were noted between the behaviour of the plants growing in the drums to which only potassium carbonate, and those to which potassium carbonate + *O. graminis,* were added. Of the 31 plants in the latter, thirteen were apparently healthy; development of the other eighteen did not continue beyond the boot stage. It was in the magnesium carbonate series that the greatest differences were observed between the behaviour of the uninoculated and the inoculated plants, only eight out of 34 heads in the latter and 22 out of 30 in the former emerging from the boot. The response of the plants growing in soil to which calcium sulphate was added was the reverse of what was ordinarily expected, because in the uninoculated drums eleven plants died at the boot stage, but all in the inoculated drums were comparatively healthy. The reason for this was not apparent.

(*b*) *In* 1939.

When the plants in the uninoculated drums were nearly two months old, differences in the rate of development and in general appearance were evident and became more and more marked as heading time approached. More or less sudden collapse and bleaching, such as happened in 1938 were, however, not observed at heading time. When the grain was ripe the plants were gathered and air-dried. The weight of those grown in soil to which hydrated lime, alone or with other bases, was added, was three times that of others grown in the control soil. In contrast, there was no significant difference between the weights of those grown in the control soil and in soil to which (*a*) ground limestone, (*b*) calcium sulphate, (*c*) ground magnesite, (*d*) sodium chloride, or (*e*) potassium carbonate was added. Tipped ears were fewer than in the preceding year.

All plants in the drums to which inoculum was added were uniformly and very severely affected; differences in soil treatment did not exert any detectable influence.

(*c*) *In* 1940.

Throughout the 1940 season the differences between the results of the soil treatments were very pronounced, plants in all drums to which only hydrated lime, or hydrated lime plus compounds of magnesium, potassium, or sodium were added, growing much better than those in drums that received ground limestone, calcium sulphate, ground magnesite, potassium carbonate, or sodium chloride.

* Unpublished work.

On 29th October, 60 plants were taken for examination of the roots and isolation of the organism from lesions on them. The worst plant was selected from each of three drums of each series. Lesions were observed on the roots of 22 and *O. graminis* was isolated from seven. Three of the seven were from pots into which the organism was not deliberately introduced.

At heading time, sudden wilting and death from take-all occurred only in two of the drums to which potassium carbonate was added, and in four of the six drums containing the control soil. Detailed examination of the harvested plants, the grain from each head, and the roots, revealed that as in the previous year there were marked differences between the effects of the soil treatments. The mean total weights of the air-dried plants grown in 1939 and in 1940 closely paralleled one another, the interaction of treatments with season not being significant. As noted in another paragraph, measures of grain size and the condition of the roots were not taken before the 1940 season.

The influence of hydrated lime is obvious from inspection of Table 1: the effects of other compounds, more particularly ground magnesite and potassium carbonate, are not apparent. The main effects and interactions with inoculation of these three compounds can be estimated from the incomplete 2 x 2 x 2 factorial arrangement, the combination potassium carbonate + ground magnesite not being present. For ground magnesite there is the additional comparison between hydrated lime + sodium chloride and burnt lime + sodium chloride + ground magnesite. In the drums to which ground limestone was added, smaller grain, more ears under standard, and better roots were produced than in the control soil, these differences being significant at about the ·01 level. In those to which calcium sulphate was added, only the root rating differed significantly at the ·01 level from the controls.

The results in Table 2 indicate that for only hydrated lime are there significant main effects in all measures of take-all symptoms, namely mean total weight, mean root rating, mean grain weight, and mean percentage of plants in a pot with half or more than half the number of ears containing grain of an average weight of less than 0·045 g. There is evidence that in the drums to which ground magnesite was added there was a significant reduction in the mean total weight, in those to which potassium carbonate was added there was a significant increase in total weight and reduction in mean grain size. Only in those to which hydrated lime was added was there significant interaction with inoculation. This is because the drums containing soil to which hydrated lime was added showed only minor differences in grain size and root condition between inoculated and uninoculated drums in contrast with those that did not contain lime.

According to all measures, there were very significant differences between drums that were inoculated in 1938 and 1939 and those that were not inoculated, the plants in the inoculated drums being superior to the others and less affected by disease. This unexpected but very significant reversal of take-all incidence in the inoculated and the control drums in the year after inoculation was obtained in three other experiments* made subsequently.

* Unpublished work.

TABLE 1.—SUMMARY OF RESULTS—1939–1941.

Treatment.	1939 Season.	1940 Season.												1941 Season.											
	Mean Total Weight.	Mean Total Weight (g.).			Mean Grain Size (g.).			Mean Percentage under Standard Ears (Angular Transfer).			Mean Root Rating.			Mean Total Weight (g.).			Mean Grain Size (g.).			Mean Percentage under Standard Ears (Angular Transfer).			Mean Root Rating.		
	Not Inoc.	Not Inoc.	Inoc.	Total.	Not Inoc.	Inoc.	Total.	Not Inoc.	Inoc.	Total.	Not Inoc.	Inoc.	Total.	Not Inoc.	Inoc.	Total.	Not Inoc.	Inoc.	Total.	Not Inoc.	Inoc.	Total.	Not Inoc.	Inoc.	Total.
$Ca(OH)_2$*	103·7	84·7	97·7	91·2	·0578	·0560	·0569	8·0	0·0	4·0	1·13	1·07	1·10	43·7	60·0	51·8	·0505	·0500	·0502	16·0	27·7	21·8	1·0	1·0	1·0
$MgCO_3 + Ca(OH)_2$	101·0	67·3	80·3	73·8	·0578	·0510	·0544	0·0	0·0	0·0	1·13	1·13	1·13	43·7	53·0	48·3	·0450	·0540	·0495	38·0	11·7	24·8	1·3	1·2	1·25
$NaCl + MgCO_3 + Ca(OH)_2$ ..	88·0	58·0	81·0	69·5	·0530	·0520	·0525	28·0	17·0	22·5	1·50	1·73	1·62	..	..	..	..	..	..	..	..	..	..	..	..
$K_2CO_3 + MgCO_3 + Ca(OH)_2$ ..	109·0	79·7	71·3	75·5	·0535	·0516	·0526	8·0	0·0	4·0	1·00	1·20	1·10	..	..	..	..	..	..	..	..	..	..	..	..
$NaCl + Ca(OH)_2$	81·3	77·0	101·7	89·3	·0493	·0511	·0502	20·3	16·0	18·2	1·43	1·37	1·40	..	..	..	..	..	..	..	..	..	..	..	..
$K_2CO_3 + Ca(OH)_2$	78·3	85·0	129·0	107·0	·0510	·0515	·0512	10·0	8·0	9·0	1·18	1·00	1·09	46·0	45·0	45·5	·0530	·0510	·0520	0·0	23·3	11·7	1·0	1·1	1·05
Ground Limestone	34·0	18·3	31·3	24·8	·0280	·0471	·0376	80·0	35·7	57·8	2·27	1·07	1·67	9·3	9·0	9·2	·0440	·0445	·0443	49·7	33·3	41·5	1·5	1·2	1·35
$MgCO_3$	29·3	27·3	34·7	31·0	·0395	·0531	·0463	64·0	33·0	48·5	2·00	1·33	1·67	8·0	6·3	7·2	·0450	·0405	·0427	49·7	53·3	51·5	1·6	1·6	1·6
K_2CO_3	24·7	22·7	45·7	34·2	·0290	·0516	·0403	78·3	21·0	49·7	2·43	1·07	1·75	8·0	8·0	8·0	·0365	·0445	·0405	62·3	50·0	56·2	2·1	1·4	1·78
$CaSO_4$	34·7	15·3	32·7	24·0	·0508	·0495	·0502	18·3	25·0	21·7	1·63	1·13	1·38	..	..	..	..	..	..	..	..	..	..	..	..
Check	30·5	18·5	26·8	22·7	·0430	·0493	·0471	46·2	25·5	35·8	2·45	1·80	2·21	10·7	9·0	9·8	·0335	·0345	·0340	86·0	76·2	81·1	1·8	1·75	1·78
Critical differences between means at 1 per cent.	21·9	27·1	27·1	19·2	·0108	·0108	·0076	36·3	36·3	25·7	0·85	0·85	0·60	17·42	17·42	12·32	·0121	·0121	·0085	48·2	48·2	34·1	0·83	0·83	0·59
Significance at—																									
Treatments	..	P < ·001			P < ·001			P < ·001			P < ·001			P < ·001			P < ·001			P < ·001			·01 > P > ·001		
Inoculation	..	P < ·001			P < ·001			P < ·001			·05 > P > ·01			n.s.			n.s.			n.s.			n.s.		
Interaction	..	n.s.			P < ·001			·05 > P > ·01			·01 > P > ·001			n.s.			n.s.			n.s.			n.s.		

* When applied in 1938 the lime was partly carbonated.

TABLE 2.—EFFECT OF THREE COMPOUNDS.

—	Chemical.	Mean Total Weight.		Mean Grain Size.		Mean Percentage under Standard.		Mean Root Rating.	
		Mean.	Significance.	Mean.	Significance.	Mean.	Significance.	Mean.	Significance.
1940 SEASON.									
Main effects ..	$Ca(OH)_2$	50·86	P < ·001	·0096	P < ·001	— 40·3	P < ·001	— ·77	P < ·001
	$MgCO_3$	— 15·05	P < ·001	·0001	n.s.	2·0	n.s.	— ·07	n.s.
	K_2CO_3	9·67	·05 > P > ·01	— ·0048	·01 > P > ·001	7·6	n.s.	— ·17	n.s.
Interactions with inoculum	$Ca(OH)_2$	5·22	n.s.	— ·0084	P < ·001	16·5	·01 > P > ·001	·41	·01 > P > ·001
	$MgCO_3$	— 6·87	n.s.	— ·0004	n.s.	— 3·7	n.s.	·09	n.s.
	K_2CO_3	4·05	n.s.	·0039	·05 > P > ·01	6·4	n.s.	·17	n.s.
1941 SEASON.									
Main effects ..	$Ca(OH)_2$	40·2	P < ·001	·1215	P < ·001	— 43·47	P < ·001	— ·61	P < ·001
	$MgCO_3$	— 3·10	n.s.	·0400	n.s.	— 13·25	n.s.	·04	n.s.
	K_2CO_3	— 4·10	n.s.	·0410	n.s.	— 17·57	n.s.	·01	n.s.
Interactions with inoculum ..	$Ca(OH)_2$	4·67	n.s.	— ·0035	n.s.	4·53	n.s.	·12	n.s.
	$MgCO_3$	— 1·75	n.s.	·0100	n.s.	— 6·10	n.s.	— ·01	n.s.
	K_2CO_3	— 3·90	n.s.	·0135	n.s.	2·30	n.s.	— ·18	n.s.

(*d*) *In* 1941.

During the first ten weeks, all the seedlings except those in the drums to which ground calcium carbonate was added gave every indication of producing equally good crops. It was only after brairding that differences between treatments began to appear; the differences increasing as the plants matured. Isolations were made of the organisms from the roots of all seedlings in excess of six per pot, but owing to an unfortunate misunderstanding the cultures were discarded before final examinations and notes were made. Whiteheads were observed and tagged but were not recorded. In the harvested plants the effects of the treatments were less evident than in 1940, but substantially the same trends were observed. The only important effects were observed in the drums to which hydrated lime was added, the differences according to all four standards being highly significant (Tables 1 and 2). Differences between the drums used as controls and others inoculated in 1938 and 1939 were indicated in the total weight, grain size, and root ratings, but they were not significant. The results obtained in 1939, 1940, and 1941 are summarized in Tables 1 and 2.

4. Discussion.

In three consecutive years the effects of *O. graminis* on wheat grown in a lot of soil to which an excessive amount of hydrated lime was added were consistently much less marked than in other plants grown in the same soil without lime. From other experiments that are to be reported later the tentative conclusion may be drawn that similar results might not be obtained with every sample of soil even from the same general district. Nor were differences observed when relatively small amounts of hydrated lime were used such as are ordinarily applied to soils that require lime.

Beneficial results of additions of generous amounts of lime to soil used in pot or cylinder experiments are discussed by Lipman and Blair (6), Mooers (9), and incidentally by Hynes (4). Although the underlying reasons for the good response of wheat to additions of the large amounts of hydrated lime and the poor response to other forms of calcium used in these experiments are obscure, the effect of such additions on growth and yield appears to be due to increased availability of some nutrient or nutrients, the resulting vigorous growth contributing to the resistance of plants to the effects of organisms that may have invaded the roots. The supply of nutrients made available year after year from such small amounts of soil is reflected in the relatively better growth and yield.

Another result that contributes to the view that available plant food in the soil profoundly influences the effect of *O. graminis* in wheat is the remarkable difference in growth in the second year in the previously inoculated and uninoculated drums, respectively. The extent of development of the plants and of take-all damage in the second year are almost the reverse of those obtained in the first year. Plants in the drums inoculated in the previous year are almost without exception thriving and healthy, those in the drums that were not inoculated are usually poor and extensively diseased. Such a reversal of effect appears to be a curious exception to the almost general rule that damage to

plants by root diseases tends to increase in successive years. The influence on *O. graminis* of availability of plant foods in soils and their relation to take-all need critical study.

The appearance of the disease in the second year in uninoculated drums suggests that the organism may have been transferred from those inoculated in the previous year. Transference may occur during weeding, watering, and other cultural operations if adequate precautions are not taken. It is, however, unnecessary to postulate such accidental transfer because the organism may be isolated from roots of young wheat plants grown in soil freshly collected from localities in which wheat was not grown for many years previously, if at all.

Although it was assumed that *O. graminis* and other root-rotting organisms were likely to be present in the soils used in these experiments, no attempts were made to eliminate them by sterilization because of the attendant unknown modifications in physical and chemical composition of the soil by heating. The elimination of root-rotting organisms would have been ephemeral and would have availed little in experiments that were planned to be continued for some years.

In most of the greenhouse experiments hitherto reported on this group of diseases, the causal relationship of *O. graminis* and other organisms to take-all has been based on the extent of blighting and root rotting of seedlings, not on symptoms such as occur in mature plants in the field. However, the amount of seedling blight or seedling root-rot is not necessarily an indication of the damage that may be expected at harvest time. In these experiments the occurrence of the disease at maturity in 1940 and 1941 could not have been predicted by the appearance of the seedlings during the first few weeks of growth because nearly all were in uniformly excellent condition. It was also observed that the few poorer types of seedlings did not necessarily develop into plants showing symptoms of take-all at maturity.

Because the appearance of seedlings was not necessarily indicative of the reaction of plants to the disease at maturity, more reliable criteria than seedling blight and seedling root-rot were sought. The numbers of white-headed plants obtained in the experiments here reported, though indicative of trends, were not consistently large enough to be statistically significant, therefore some of the associated symptoms of the disease, already enumerated in preceding paragraphs, were used as criteria. All are associated with take-all in the field, they are apparently interdependent, and each is almost as reliable a criterion as the other. In due course experiments will be made, using larger populations to determine whether significant numbers of white-headed plants are obtainable under conditions similar to those reported here.

During the first and second years of this experiment mathematical treatment of the results was not contemplated, consequently only the general trends were noted. Towards the end of the third season, however, it appeared desirable to record the striking differences between treatments in more exact form than previously. In another paper that is now in course of preparation for publication, complete data relating to another experiment on the same subject are recorded. According to those results control of take-all is obtained in the second as well as in the first year if rather larger amounts of lime are applied to the soil than is usual even in intensive agriculture. The mechanism of control is, however, not yet apparent.

5. Acknowledgment.

The biometrical work here reported was done by Mr. G. A. McIntyre, Assistant Biometrician, C.S.I.R., whose help is gratefully acknowledged.

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Separation of Ergot from Rye Corn.

By Enid C. Plante, B.Sc., A.A.C.I., and K. L. Sutherland, M.Sc., A.A.C.I.**

Prior to the war Australia imported the drug ergot from Spain and Central Europe. It is regarded as an essential drug, and the war-time requirements have exceeded those of peace time. The source of the alkaloid, ergot, is in a fungus which grows upon rye as a host. During the past three years Mr. Pittman, of the Victorian State Agricultural Department, with the co-operation of the Council's Division of Plant Industry, has been experimenting upon the artificial infection of rye crops with ergot. He has been successful in considerably raising the yield of ergot per acre.

It is understood that in Europe a separation of ergot from rye is made by immersing the crop in a 30 per cent. salt solution and then either hand-picking the ergot concentrate or allowing fowls to remove the grain. In Australia, crops of rye corn containing 4 per cent. ergot are being grown, and the problem is to remove the 96 per cent. of grain so that the final product does not contain more than 2 per cent. organic impurity. A density separation in a saline solution (specific gravity, 1·15) raises the ergot content to 50 per cent. without losing ergots in the rejected grain. Attempted separations in solutions of specific gravities less than 1·15 lead to considerable losses of ergot. The usual seed cleaning methods—air flotation, sieving, rolling down slopes, &c.—also failed to yield satisfactory recoveries.

Since density separations are unsatisfactory we were asked to attempt a separation using the surface properties of the two grains. We have been able to show that rye corn possesses a wax-coated (hydrophobic) surface whereas ergot does not. In water, air bubbles will attach themselves to a wax surface so that the density of the aggregate, grain and air bubble, is less than that of the grain alone. A separation of ergot from corn is then feasible.

A continuous method of attaching air bubbles to particles (grains) so that their density is less than water, is the flotation method used for the separation of minerals. Now the size of air bubbles which can be attached to the rye grains is insufficient to buoy the grain to the surface. That is, the surface of the grain is insufficiently hydrophobic. Consequently, to increase the size of air bubble that can be attached, an emulsion of purified paraffin oil, the droplets of which adhere and spread over the hydrophobic rye surface, but which do not adhere to the hydrophilic ergot surface, is added to the grain-ergot mixture. This oiled grain can be efficiently separated in a flotation cell, which should be of the pneumatic type to provide gentle agitation and good air dispersion. The impellor of a sub-aeration mechanical machine breaks the ergots and grain which leads to an unsatisfactory separation. The pneumatic machine produces an ergot product containing only 1 per cent. or less of impurity with a 95 per cent. or better recovery. Preliminary estimates of the cost of separation is 3d. per lb. of ergot, the market price (English) of ergot being about 8s. per lb.

A complete account of the work will be published when pilot scale tests which are being carried out on this year's crop are complete.

* An officer of the Division of Industrial Chemistry.

The Veneer Lathe of the Division of Forest Products.

The Division of Forests Products' veneer lathe has been one of its most important items of equipment as far as research bearing on the war effort is concerned. The lathe was presented to the Division by Mr. W. Russell Grimwade, and this generous gift enabled the Section of Veneering and Gluing to be established. Mr. Grimwade retired from the Council as from the end of December last, but immediately before his retirement, the Chief of the Division (Mr. I. H. Boas) presented him on behalf of the Division with a "book" the leaves of which consisted of sample 3-ply sheets of different Australian timbers. The paragraphs that follow are taken from that "book."

The lathe was ordered from the Coe Manufacturing Co., Painesville, Ohio, U.S.A., on June 15, 1939, and it arrived in February, 1940. The length of the knife is 42 in., and the diameter of the spindles 5 in.; logs up to 48 in. in diameter can be peeled. The lathe is equipped with a transmission box for the operation of the dogging spindles and the in and out feed of the knife carriage. Change gears are used for cutting a large number of different thicknesses of veneer ranging from 1/100 in. to ⅜ in. The lathe is driven by means of a 40 h.p. constant speed motor through an Australian built Nuttall variable speed drive. A power operated clipper for sizing sheets from the lathe, a veneer drier, a glue mixer and glue spreader, two plywood presses, and an Avery testing machine of 3,000 lb. total capacity make up the accessory equipment.

By the time the lathe was ready for operation, a formidable programme had been prepared. The main investigation was necessitated by the urgency of finding a local substitute for imported aircraft plywood normally manufactured from European birch (*Betula* spp.). Scented satinwood (coachwood) (*Ceratopetalum apetalum*) from New South Wales is being used, but it just meets the strength requirements of the specification and, in addition, there are difficulties in obtaining the large number of peeling-quality logs required. Logs from nineteen different species were peeled, made up into plywood, and tested before this investigation was completed. Unfortunately, only one species, leatherwood (*Eucryphia lucida*) from Tasmania would meet the specification, and, in this case, the large number of small knots present marred the appearance of the sheet. Another drawback to the commercial use of this species is the small size of the logs available. In spite of these drawbacks, practical trials of leatherwood plywood in two aeroplanes gave most satisfactory results. A further 100 logs are now on order and arrangements made for their conversion to plywood for more extensive trials. The investigation also furnished a large amount of valuable data on the peeling, drying, and bonding characteristics, and the strength of the plywood made from a number of our most important timber species.

As a result of an inquiry from overseas for the supply of a large quantity of aircraft plywood, a comprehensive series of experiments was completed on the peeling and drying of hoop pine (*Araucaria cunninghamii*) veneer and also on the strength characteristics of the

plywood produced. Altogether, 58 billets were peeled, &c., in this investigation. The results confirmed the opinion that this species would meet the specification. A secondary aim of the investigation was to obtain supplies of suitable veneer for work in connexion with the "improved wood" and "plastic plane" investigations.

The improved wood investigations have been directed mainly at the development of suitable grades of improved wood for a number of Defence uses. Veneer peeled at the Laboratory from different species has formed the basic raw material for the manufacture of this improved wood. It is certain that without the services of the lathe these investigations would have been delayed owing to the difficulty in obtaining supplies of suitable veneer from commercial plants.

The so-called "plastic plane" has received considerable publicity of late. It undoubtedly has many advantages, but a considerable amount of work remains to be done. Tests have been carried out on the strength of curved plywood panels; experiments on the "moulding" of the plywood and the use of different adhesives are necessary. Large supplies of veneer of a number of different species are required. The lathe is now supplying this need and is thus helping to lay the foundation of another new industry.

The lathe has been invaluable in the peeling of veneer for match splints. Supplies of imported aspen splints have been cut off owing to the curtailment of shipping. Local manufacturers have experienced considerable difficulty in the peeling of Victorian mountain ash (*Euc. regnans*) as a substitute and had practically abandoned this species as a match proposition. It was shown, however, that with proper attention to the lathe set-up, preparation of the log, and the use of proper peeling technique, this species could be readily peeled into 1/12 in. veneer suitable for splints. The burning qualities of mountain ash matches are definitely superior to those of matches at present on the market made from other local species.

Experiments carried out on the peeling of myrtle beech (*Nothofagus cunninghamii*) from Tasmania were largely instrumental in the establishment of the first plywood plant in that State. Karri (*Euc. diversicolor*) has shown promise for veneering purposes, and it is probable that a plywood plant will be constructed in Western Australia in the near future. Further experimental work on this species will be undertaken shortly.

The following list of the species peeled up till September 30th, 1942, is an indication of the amount of work that has been carried out:—

Scented satinwood	60 lengths.
Hoop pine	58 "
Leatherwood	41 "
Brush mahogany	38 "
Silver ash	36 "
Myrtle beech	32 "
Queensland silver ash	30 "
Yellow carabeen	20 "
White birch	18 "
Sassafras	18 "
Mountain ash	17 "

Blackwood	12	,,
Bollywood	10	,,
Yellow walnut	10	,,
Yellowwood	9	,,
Sassafras	9	,,
Rose alder	8	,,
Celery top pine	6	,,
Kurrajong	6	,,
Corkwood	5	,,
Mountain grey gum	4	,,
Silvertop ash	4	,,
Manna gum	4	,,
Karri	4	,,
Silver wattle	4	,,
King Billy pine	3	,,
Alpine ash	2	,,
Birch	2	,,
	470	,,

It has been estimated that these 470 billets have furnished 80 miles of veneer 3 ft. 4 in. wide.

The veneer has been peeled in a large number of thicknesses depending on the purpose for which it was required. The main thicknesses have been 5/16 in., ¼ in., ⅛ in., 1/12 in., 1/16 in., 1/24 in., 3/100 in., 1/48 in., and 1/100 in. A definite cutting plan has been followed in every case, as experiments have been designed to show up any variation in properties of the veneer or plywood obtained from various positions in the log. For example, when peeling for aircraft plywood studies, veneer is cut in four thicknesses, 1/16 in., 1/48 in., 3/100 in., and 1/100 in. These thicknesses were chosen because they were very close to the thicknesses peeled commercially for aircraft plywood. In addition, 1/16 in. and 1/48 in., 3/100 in. and 1/100 in. veneer can be peeled with only one change of gears, as a special gear giving a 3:1 thickness ratio is incorporated in the machine. Two 3-ft. 4-in. billets are sawn from each log. One billet is peeled into 1/16 in. and 1/48 in. veneer in alternating bands 1 in. wide along the radius of the log. The other billet is peeled similarly into 3/100 in. and 1/100 in. veneer. Every sheet after clipping to size is given a shipment number, log number, and a figure representing the radius from which it was peeled. The record system is such that it is possible to trace individual sheets of veneer to their exact position in the log and in the case of material from Queensland, each log can be traced back to the stump in the bush.

This detail may appear superfluous, but experience has shown that variation within a species and within a tree is most important. Where the raw material is to be used for an exacting purpose, such as aircraft plywood, it must be taken into account. For example, the spasmodic occurrence of brittle heart in eucalypts has an important bearing on the utilization of veneer from this group of trees. The system of identification of affected areas and marking of the veneer ensures that faulty material will be excluded from test.

Veneer from the lathe has been utilized in many projects. The development in recent years of new types of phenol and cresol formaldehyde, urea formaldehyde, and other synthetic adhesives has necessitated a large amount of testing. An adequate supply of veneer has always been available. As a result, the work has been expedited and the information gained has been of considerable assistance in the solution of many problems in connexion with the war effort.

Veneer has also been available for other studies such as those on the development of laminated felloes for use in the construction of wheels for army wagons and the fabrication of laminated wheels to replace rubber-tyred wheels for factory trucks. The production of both types is now being undertaken on a commercial scale.

Much remains to be done, however, on the peeling of Australian timbers. The war situation has thrown emphasis on certain phases of the work of more immediate use, and many fundamental studies have been pushed into the background. The lathe should be used primarily for the development of the best technique for the cutting of timbers at present utilized for peeling purposes with the ultimate aim of improving commercial practice and, secondarily, for investigations of other species which may be used for peeling and the manufacture of plywood. Notwithstanding, it has been of immense value in the war work of the Division. Without its services the progress of many of the most important projects would have been delayed or, in many cases, prevented completely. Our thanks and the nation's thanks are certainly due to Mr. Grimwade for his magnificent gift and for the foresight he has shown in thus facilitating this phase of the Division's work.

Note on the Mapping of Soil Erosion.

By J. K. Taylor, B.A., M.S., and C. G. Stephens, M.Sc., A.A.C.I.**

Soil surveying practice covers all phases of the classification and mapping of soils. One of its aims is to show clearly the soil types and their modifications, and an important modification is imposed by accelerated erosion. A comparatively elaborate system of recording erosion and land-slopes by classes and symbols has been devised by the Soil Conservation Service in the United States of America to include a very wide range of conditions.† A certain rigidity in the system was necessary owing to the large number of surveyors concerned who were new to this type of work and whose field observations had to be correlated by a supervising staff.

Until recently no mapping of erosion and no attempt to characterize it except in very general terms had been made in Australia. During 1941, a soil, land-use, and erosion survey was carried through by the Division of Soils on 600 square miles in County Victoria, South Australia. The simple scheme adopted relies considerably on the judgment of the soil surveyor. Its basis is outlined in Table 1 below.

The topography of the area is undulating with a number of moderately steep and stony ranges which run more or less parallel for considerable distances north and south, breaking the landscape into sharply divided drainage basins. The soils belong mainly to the red-brown earth group and frequently show the effects of severe water erosion under the prevailing system of constant cultivation. There are also moderate areas of rendzina-like soils more resistant than the other types to erosive forces, some alkaline soils associated with a mallee vegetation and some small areas of podsolized soils. Wind erosion is confined to sandy "mallee" soils. The rainfall through occasional violent summer storms or heavy winter falls at critical times of the year, as at seeding, has accelerated damage on soils depleted in organic matter and in a highly erodible condition.

For the mapping of erosion, aerial photographs are essential for accuracy and speed of work. The photographs can be interpreted by the ground party and serve as an excellent base for working on in the field. The use of coloured pencils to define different types of data on the one photograph makes recording of material by the surveyor much easier.

The transfer of field data from the photographs is done on to separate plans. The use of complicated maps showing several groups of data is not desirable unless a very large scale can be used. For publication purposes this is not practicable and, since erosion maps are liable to rapid change, not warranted. For record purposes and design of conservation measures, details are therefore transferred to maps showing soil boundaries on as large a scale as possible; in the case of County Victoria 40 chains to 1 inch was sufficient.

* An officer of the Division of Soils.

† Soil Conservation Handbook. U.S.D.A. Misc. Pub. 352 (1939).

TABLE 1—EROSION CLASSES AND FIELD CHARACTERISTICS.

Erosion Class.	Type of Erosion.	Degree of Erosion.	Field Characteristics.
0	Nil	Nil	No changes produced other than normal for geological erosion
1	Sheet removal	Slight—by water action	Amount of soil removed small in proportion to depth of surface soil. Cultivation and productivity of soil not affected
2	Sheet removal	Significant—by water action	Amount of soil removed becoming serious. Subsoil disturbed by cultivation. Productivity decreased. Regeneration under pasture or wide rotation necessary with or without control structures
3	Sheet removal	Severe — by water action	Very serious removal of surface soil extensively exposing subsoil which may also be partly removed. Productivity badly affected. Regeneration under pasture difficult. Control structures necessary
4	Removal by gullying	Shallow gutters and rills—incipient gullies	Shallow washing in gutters and rills not penetrating subsoil. Gutters can be filled by cultivation and crossed by implements. Control by simple measures
4F			Shallow gutters less than 5 chains apart. Control measures necessary
5	Removal by gullying	Gullies of varying depth	Gullies penetrate subsoil or deeper into parent material cannot be filled by cultivation or crossed by implements. Control measures necessary with or without structures
5F			Class 5 gullies less than 5 chains apart
5V			Deep steep-sided gullies penetrating to deep subsoil or parent material
$\overline{5}$			Stabilised gully of class 5

TABLE 1—*continued.*

Erosion Class.	Type of Erosion.	Degree of Erosion.	Field Characteristics.
6	Sheet and fan accumulation	Shallow—deposition by water action	Shallow cover of washed material not sufficiently deep to affect cultivation and/or productivity
7	Sheet and fan accumulation	Significant—deposition by water action	Wash deposits deep enough to affect cultivation and/or productivity
8A	Accumulation..	Slight—by wind action	Slight wind erosion resulting in scattered small hummocks or shallow drift
8B	Removal ..		Slight wind erosion resulting in lightly blown out or lightly windswept conditions
	NOTE.—Neither form affects crop production seriously but some control measures for stabilization are required.		
9A	Accumulation..	Significant effects by wind action	Moderate to severe wind erosion resulting in dunes or extensive drift deposits or numerous hummocks
9B	Removal ..		Moderate to severe wind erosion resulting in serious blown out or windswept areas
	NOTE.—In both cases cultivation and productivity are badly affected and stabilization is imperative.		

Comments on Erosion Mapping.

(1) The notes in Table 1 refer to land which is under cultivation or rotations including cultivation. The literal application of the erosion classes to permanent pasture conditions is not practicable as the soils are often not cultivatable. On slopes, pasture land is mapped in erosion class 1, even if no obvious signs of removal exist, unless a complete sward is present. The idea should be to foresee the trend of erosion under grazing, since rehabilitation by cultivation is impossible on many steep slopes. On such and on shallow and skeletal soils the loss of ground cover with 10 per cent. of surface soil removed may be extremely serious. This is an example where judgment of the surveyor is necessary and not reliance on percentage removal of surface soil.

(2) In no case is class 4, or rarely 5, gully erosion mapped without an accompanying sheet erosion symbol 1, 2, or 3. Where land is under

some form of cultivation the erosion mapped varies between the following extremes:—

1 = Slight sheet erosion only.

35VF = Severe sheet erosion exposing subsoil with deep steep-sided gullies less than 5 chains apart.

(3) A soil erosion survey records the present position; it serves the soil conservation officer and the farmer as a plan of damage to be countered by suitable design of structures and farm management. A single storm can alter the whole face of the farm landscape. There are therefore limitations on the detail required for record, and the surveyor must see not only the present state but understand the history of degeneration, the probable cause, and the speed of future deterioration or improvement under existing form of management.

(4) It follows from the last conclusion that an erosion survey to be complete needs to be accompanied by land use mapping and an inquiry on farm management.

(5) The aerial photographs allow the definition of steepness of slopes and the line representing critical "break of slope" in the descent to the valley floor. With the construction of soil and land use maps in addition, there does not seem any reason for detailed slope mapping. The definition of the boundaries of drainage basins is a necessary part of erosion mapping. For the appreciation of the extent and progress of erosion, therefore, these boundaries for all rivers, creeks, and even small tributaries were mapped as essential for showing source and volume of flow. Conservation practices can only be designed properly on the spot, and where these are necessary the slope factor can be evaluated on each occasion on the farm or unit area. In the survey of County Victoria and as a general principle, slope mapping is not considered necessary for the broad picture.

The use of aerial photographs as a base map for field plotting of erosion is demonstrated in Plate 7 taken from the County Victoria survey. The boundaries separating areas of different erosion character are not shown to avoid covering photographic detail unduly. They are normally sketched in the field on the photograph during the survey.

Report on Work of Research Station, Merbein, submitted to the Advisory Committee of the Station.

General.

The work of the Station in accordance with the functions and constitution of the Council is primarily directed to research and investigation.

The Dried Fruit Industry is highly organized, and on this account desires specialized technical services of a character not ordinarily rendered by the Council. The grant of the Export Control Board is for the purpose of these specialized services; and to a limited extent, for assistance and co-operation in large scale administrative work, including the irrigation of community settlements. The principal specialized services rendered to the industry are given below.

Seasonal Studies in Maturity.

There is at present a very consistent demand from growers for information regarding the seasonal development of the vines and the maturation of the grapes. The Australian climate is extremely variable, and each year adjustments based on seasonal conditions are necessary in such important operations as spraying, irrigation, and commencement of harvest.

Regular records are made of the date of sprouting, average temperature, the incidence of disease, the shoot and berry growth, and the density and acidity of the grape juice. From these data, it is possible to issue periodic recommendations in reference to important seasonal work. Spraying, for example, has two viewpoints. Considerable damage can result by neglect to spray when seasonal conditions and the incidence of disease make neglect very dangerous. Conversely in the River Murray Areas, there are many periods when spray applications are unnecessary. The status of the vineyards in reference to disease is continually watched, and the information passed on to growers.

Last season, irrigation adjustments were necessary on account of the shortage of fuel. By a close study of seasonal conditions and vine development, and the elimination of the cover crops, it was found possible to reduce the quantity of water applied without danger to yield. The Station also suggested to the State Rivers and Water Supply Commission and to the Irrigation Boards that the pre-harvest irrigation be staggered so as to provide water at later dates for those portions of the individual holdings which would be harvested late on account of labour shortage. The recommendation was adopted, and the quality of the grapes at late harvest preserved.

Another recommendation ultimately adopted was the elimination of cover crops, to reduce autumn applications; and also to provide more effective soil moisture for the following spring. These departures from normal practice were necessary as " war time " measures, on account of shortage of labour and fuel.

The chief information of practical value in reference to grape development was obtained after the December heat wave, which was characterized by an increase of over 20°F. in the average maximum temperature compared with that of the previous month. The result of the unusual season was a cessation of grape growth, accompanied by an acidity fall and a sugar rise at a quicker rate than previously experienced. This justified a recommendation for early harvest, in opposition to the general impression of growers that maturation was delayed. The recommendation proved particularly fortunate, as the break in the drying season was sudden and decided. Losses in fruit and mould development were inevitable, and were mainly associated with labour shortage. Undoubtedly it can be affirmed that the move for an early harvest saved many tons of fruit, and also increased the proportion of high grade fruit.

The cost of these routine operations is considerable, one item (irrigation rates) in the Mildura district being £100,000 per year. Assistance to the growers in rendering this expenditure more effective may thus be considered desirable.

Potash Substitutes for Use in Dipping Sultanas.

Dipping trials have been carried out with the object of finding a substitute for imported potassium carbonate for use in dipping sultanas and other vine fruits. No other chemical substance has been found to date which is entirely satisfactory, but it has been shown that suitably prepared extracts of vine ash, in which potash is the main constituent, give results which are equally good. The ash obtained by burning packing house waste consisting of stems, immature fruit, &c., usually contains about 35 per cent. extractable potash, and is giving very satisfactory results as a substitute for refined potash in dipping sultanas.

It has also been shown that by using suitable wetting agents in the cold dip the potash strength may be safely reduced from 4 or 5 per cent. to 2·5 per cent. without adversely affecting the drying rate, while the quality is sometimes improved, and as a result of more efficient drainage approximately 20 per cent. less dip solution is used up. The resulting saving in potash is appreciable.

Cottonseed Oil as a Substitute for Olive Oil in Dipping Sultanas.

Investigations have been carried out over a number of years on oil emulsions for use in dipping sultanas. As a result of this work it was found possible to substitute Australian produced cottonseed or peanut oils for imported olive oil with equally satisfactory results. This is very fortunate in view of the fact that olive oil is not obtainable. The change over to cottonseed oil has been made without affecting dipping procedure or the quality of the dried product.

Storage Trials on Apricots and Peaches Packed in Tins.

The Supply Department has recently been purchasing dried fruits packed in sealed tin containers for use by the services. In order to obtain information regarding the keeping qualities of dried apricots and peaches when packed in tins, and the optimum moisture and sulphur dioxide contents, storage trials are being carried out with these fruits.

In order to provide a satisfactory packing-house method for the determination and control of moisture contents, the electrical moisture meter has been calibrated for these fruits and the necessary tables prepared.

Control of Mould on Racks and Dehydration of Damaged Fruit.

The labour shortage during the last harvest resulted in the drying season being more prolonged than usual, and as unfavourable drying weather was experienced during May, a certain amount of damage by rain and mould growth resulted. Investigations have been carried out on the prevention of mould growth on the racks, and on the subsequent packing-house treatment and dehydration of damaged fruit. It has been shown that mould growth can be controlled to a considerable degree by either enclosing the racks and burning sulphur beneath the racks under suitable conditions, or by spraying thoroughly with a 1 per cent. solution of sodium salicylanilide in water.

Packing House Treatment of Rain Damaged Sultanas and Lexias.

Owing to unfavourable drying conditions during the latter part of the drying season, a considerable amount of mouldy and rain damaged fruit was delivered to some of the packing houses for treatment last season. Opportunity was thus afforded for carrying out further experiments with this class of fruit. It was shown that further mould growth could be prevented, for at least one or two weeks, by sulphuring filled or partly filled sweats of fruit for 1 to 2 hours. This operation was carried out on a concrete floor out of doors, using a citrus fumigation tent supported by empty sweats as a sulphur box. The amount of sulphur dioxide remaining in the fruit after washing and dehydrating was practically nil. The treatment also appreciably improved the colour of the finished product.

In connection with the washing and dehydration of this class of fruit, further confirmation was obtained regarding the merits of the casein type of paraffin oil emulsion. When emulsions of this type were used as a wash prior to dehydration, the resulting dried product did not pick up moisture again and become sticky to anything like the same extent as was the case with the emulsion used previously. Apparently the casein assists in sealing cracks by applying an artificial skin where the berries are damaged.

The use of the casein type of emulsion in the treatment of rain damaged fruit, marks a definite advance in packing-house practice. This type of emulsion is also being used with excellent results in the oil treatment of lexias after seeding.

Viticultural Investigations.

Many of the investigations of a minor nature have been dropped; but in long dated investigations, where the cumulative effect is of most value, the treatments are being continued, though in some cases the measurement of yield has been dropped for the present.

Viticultural investigations which are continued in this way include fertilizer trials, pruning, cincturing, trellising, tipping and topping, disbudding, application of oil emulsions to delay sprouting, and the effect of minor elements.

Oleic Acid Supplies.

The Controller of Materials Supply recently approached the Commonwealth Dried Fruits Control Board regarding the possibility of reducing the amount of olein (commercial oleic acid) used by the industry. At the present time olein is being used in the preparation of two different types of oil emulsion. In packing-house operations olein is used in conjunction with potassium carbonate in emulsifying paraffin white oil in an emulsion which is employed as a wash for dried vine fruits, mainly sultanas and lexias. The quantity of olein used for this purpose varies from season to season according to the condition of the fruit, but would normally be about 500 to 700 gallons per season.

If the necessity arises a saving of olein can be effected by using a paraffin oil-casein-water emulsion instead of an olein emulsion. If the olein emulsion were replaced by the casein type, the quantity of olein required per annum would be only 20 to 30 gallons and results obtained would be equally satisfactory.

Olein is also used in the preparation of oil emulsions for dipping purposes. That made by the packing houses in this district was developed by this Station and consists of a cottonseed oil-olein mixture emulsified in water by means of triethanolamine. It contains 60 per cent. by volume of oil mixture and 2 per cent. by volume of triethanolamine. The oil mixture contains 85 per cent. cottonseed oil and 15 per cent. olein by volume. About 10,000 to 12,000 gallons of this emulsion is made each season, so that the amount of olein required is roughly 1,000 to 1,200 gallons. If the necessity arises the proportion of oleic acid used in the oil mixture could be reduced to 10 per cent. by volume without greatly affecting the results obtained in dipping fruit. It might even be possible to reduce it to 5 per cent., but in this case the addition of more wetting agent to the dip would probably be necessary where the cold dip is used.

It may be possible to find a satisfactory substitute for oleic acid, but this will necessitate further field trials. Up to the present, emulsions have been marketed containing a much higher proportion of oleic acid than is necessary with the triethanolamine type of emulsion. A considerable saving of olein can be effected if for the time being emulsions of the triethanolamine type are used exclusively for dipping purposes.

Publications.

Three publications dealing with the investigations of the Station have been prepared. Of these, one bulletin "Production of Dried Grapes in Murray Valley Irrigation Settlements" Part 1, Viticulture, has been published and circulated among growers of dried fruit. Part 2, "Irrigation, Drainage, and Reclamation," and also a technical pamphlet on the same subject, have been printed.

Staff.

Of the permanent staff establishment of thirteen officers, six have left for various forms of war work, including four in the Air Force. The general effect of the war on the work of the Station has been a decrease in the purely investigational work, and an increase in problems of re-adjustment rendered necessary by the war.

NOTES.

Introduction of Scale Parasites from California.

(*Contributed by T. G. Campbell.*)

Two useful parasites of scale insects have recently been introduced into Australia by the Council's Division of Economic Entomology, at Canberra. Arrangements for the introduction of these parasites were made by the Director of the Imperial Parasite Service, Belleville, Canada. Consignments of the parasites were obtained from the Riverside Citrus Experiment Station, of the University of California, whose entomologists have been responsible for the successful introduction and establishment of both species of parasites in California within the last few years. Consignments of the parasites were brought into Australia from California by air ferry, a method which proved highly successful, and which overcame any difficulties arising from the necessity for carrying the insects at low temperatures.

Both parasites are minute wasps belonging to the Chalcidoid family Encyrtidae, and complete their development within the bodies of their hosts. One is a new Chinese race of *Comperiella bifasciata*, which is capable of developing in red scale of citrus, *Aonidiella aurantii*, although it also attacks other closely related scales of lesser economic importance. *Comperiella bifasciata* was first recorded as a scale parasite as early as 1900 and was described in 1906. In the interval since 1900 several attempts have been made to establish it on *A. aurantii* in California, but without success. However, the original race of the parasite did succeed in establishing itself on other related scales of considerably less economic importance. An earlier attempt to establish this original race of *Comperiella* in New South Wales proved unsuccessful. The material then had to be brought from California at low temperature, and although live parasites reached Australia they failed to become established.

The new race of *Comperiella*, capable of developing in red scale, has been introduced into the United States of America from China by air during the last two years, and has now been established in citrus areas in California for about a year. The period which has since elapsed is as yet rather too short to enable any satisfactory conclusions to be drawn as to its economic value, since it is only by actual field experience that the effect of a parasite on its host in a new habitat can be determined. It is felt, however, that attempts to establish the Chinese race on red scale in Australia will be well worth while, particularly in the warmer areas where citrus culture is carried on.

The second species of Encyrtid is *Metaphycus helvolus*. It was first introduced into California from South Africa in 1937, and has since been established in citrus growing areas. While primarily introduced into the United States as a parasite of the brown olive or black scale, *Saissetia oleae*, *Metaphycus* also attacks several other related species of scale insects. Recent reports indicate that *Metaphycus* is the most important of the various species of parasite Chalcidoid wasps now established on *Saissetia oleae* in California and has become a dominant factor in the reduction of this scale over a wide area.

Small colonies of both *Comperiella* and *Metaphycus* have now been established at the Council's laboratory in Canberra. Arrangements are

in progress, in collaboration with State entomologists, for the breeding and liberation of these parasites in selected citrus growing areas. For the time being at least, it is not intended to make any general distribution of these parasites.

Review.

"Take-all Disease of Cereals," by S. D. Garrett.

(Technical Communication No. 41 of the Imperial Bureau of Soil Science, Harpenden, England, 1942, pp. 40. Available from Imperial Agricultural Bureaux, Central Sales Branch, Agricultural Research Building, Penglais, Aberystwyth, Wales. Price 2s. 6d., post free.)

In the past the take-all disease has been closely associated with intensive production of wheat, especially in the newer cereal-growing areas of Australia, North America, and South Africa. During the present war, with its difficulties of food production and food transport, many farmers in different parts of the world will be growing wheat more frequently than before, whilst others will be growing this crop for the first time. Plant pathologists and cereal-growing experts may anticipate a flare-up of this disease in some areas, and in other areas a first appearance of the trouble.

It is therefore to the plant pathologist or cereal expert in the field that this Technical Communication is especially addressed—whether he is on the look-out for the first appearance of the take-all disease, or whether he is concerned with the translation into local field practice of the latest findings of research. No effort has been spared to make this monograph comprehensive, however, and chapters on the physiology and morphology of the causal fungus, *Ophiobolus graminis,* and on the pathological histology of the disease, have been included for the benefit of mycologists and plant pathologists. Of general interest to plant pathologists will be the account of the first appearance of this disease in crops on virgin land, and of the factors underlying its fluctuations in intensity from year to year on the older cereal-growing areas. In the concluding chapter of the review, the findings of research are summarized and concisely translated into terms of field practice.

Recent Publications of the Council.

Since the last issue of the *Journal,* the following publications of the Council have been issued:—

Bulletin No. 150.—"The Soils of the Parishes of Longford, Cressy, and Lawrence, County Westmorland, Tasmania. 1.—A Soil Survey of the Area. 2.—Pot Experiments with Subterranean Clover on the Cressy Shaley Clay-Loam," by C. G. Stephens, M.Sc., A.A.C.I., J. G. Baldwin, B.Agr.Sc., B.Sc., and J. S. Hosking, M.Sc., A.I.C., A.A.C.I.

This Bulletin deals with the most notable pasture problem in Tasmania, namely, the failure of superphosphate to establish and maintain pastures of subterranean clover on certain soils located in the Launceston Tertiary Basin. One of the soils, the Cressy shaley clay-loam, is probably unique in Australia in its power to render superphosphate insoluble and thus of little value to plants. Experiments showed that much improved production of subterranean clover on this soil may be obtained by the initial addition of 1 to 5 cwt. of magnesia,

5 to 10 cwt. of slaked lime, or about 1 ton of ground limestone or dolomite to the acre. These amounts should be incorporated in the top half-inch of the soil; deeper incorporation would require heavier dressings.

Bulletin No. 151.—" The Control of St. John's Wort (*Hypericum perforatum* L. var. *angustifolium* D.C.) by Competing Pasture Plants," by R. M. Moore, B.Sc.Agr., and A. B. Cashmore, M.Sc.

Experiments described in this Bulletin showed that subterranean clover in association with perennial grasses such as *Phalaris tuberosa* or perennial ryegrass almost completely eradicated St. John's wort, and provided a productive and nutritious pasture for stock. The best method of controlling the weed is to sow a mixture of *Phalaris tuberosa* and subterranean clover with superphosphate on a carefully prepared seed-bed which has been fallowed during the preceding summer. Cheap and effective control may also be obtained by broadcasting subterranean clover and superphosphate on infested land which has been lightly cultivated with a rigid-tine scarifier. Mowing and burning are not recommended. Both ploughing and mowing plus burning increase the density of St. John's wort. It is believed that the main factor in the control of the weed is the reduction in light intensity under the sward.

Bulletin No. 152.—" Soil Survey of Part of County Moira, Victoria, including the Parishes of Boosey, Cobram, Katamatite, Naringaningalook, Katunga, Yarroweyah, and Strathmerton," by B. E. Butler, B.Sc.Agr., J. G. Baldwin, B.Agr.Sc., B.Sc., F. Penman, M.Sc., and R. G. Downes, M.Agr.Sc.

This Bulletin describes the results of a survey of part of County Moira, Victoria, which is to be supplied with irrigation water from the Yarrawonga weir. The area is a uniform plain, having a few sand hills as its most prominent feature, and it forms part of the flood-plain of the Murray Valley. The present agricultural system is one devoted primarily to wheat and fat lamb production. The soils have a moderately high standard of fertility and most of the land is arable. The climatic conditions from November to March are so arid as to prevent growth, but it is estimated that, by the addition of about 24 inches of irrigation water, this period may be made the most productive of the year. With the water-rights proposed, it is estimated that when the irrigation system is completed, one-quarter to one-sixth of the area will be irrigated. The soils of the area are low in salt and the water-table deep; provided care is taken in irrigation practices, the more disastrous ills sometimes associated with irrigated areas should be avoided.

Bulletin No. 153.—" Pelagic Tunicates in the Plankton of South-eastern Australian Waters, and their Place in Oceanographic Studies," by H. Thompson, M.A., D.Sc., with a Statistical Analysis of Data on Total Plankton, by G. L. Kesteven, B.Sc.

This Bulletin is the first of several reports on the oceanographic operations carried on incidentally in conjunction with exploratory work aiming at the evaluation of Australian pelagic fishery resources. The pelagic Tunicates comprise, next to Crustacea, the chief portion of the zooplankton of the south-eastern Australian area, and they are suitable to serve as " indicators " of changing oceanographic conditions which affect the course of the fishery. Comparison of the types and relative numbers of plankton in Australian waters with those in other

regions shows a much closer affinity with south Japanese and Philippine and Indo-Malayan than with Californian conditions. Hence there is a distinct probability that fisheries of south-eastern Australia will develop on west—rather than on east—Pacific lines.

Supplement to Handbook of Structural Timber Design.—A 28-page supplement to the Second Edition of the Handbook of Structural Timber Design entitled "Large Timber Structures—Notes on Design, Specification, and Inspection," has just been published. This presents, in the form of notes, a number of points which should be of assistance in the design, specification, and inspection of the numerous large timber structures now being constructed. Copies may be obtained gratis on application to the Chief, Division of Forest Products, Yarra Bank-road, South Melbourne, S.C.4, Victoria.

Forthcoming Publications of the Council.

At the present time, the following future publications of the Council are in the press:—

Bulletin No. 154.—"The Handling and Storage of Australian Oranges, Mandarins, and Grapefruit." Report of Investigations carried out under the direction of the Citrus Preservation Technical Committee from 1935 to 1941, and compiled by F. E. Huelin, B.Sc., Ph.D.

Bulletin No. 155.—"The Lubricating Effect of Thin Metallic Films and the Theory of the Action of Bearing Metals," by F. P. Bowden, Sc.D. (Cantab.), and D. Tabor, Ph.D. (Cantab.), A.R.C.S.

Bulletin No. 156.—"Standardized Plant Names. A List of Standard Common Names for the more Important Australian Grasses, other Pasture Plants, and Weeds," prepared by the Division of Plant Industry.

Bulletin No. 157.—"Studies in the Biology of Australian Mullet. 1.—Account of the Fishery and Preliminary Statement of the Biology of *Mugil dobula*, Gunther," by G. L. Kesteven, B.Sc.

Bulletin No. 158.—"The Recovery of Inter-block Information in Quasi-Factorial Designs with Incomplete Data. 1.—Square, Triple, and Cubic Lattices," by E. A. Cornish, M.Sc., B.Agr.Sc.

Bulletin No. 159.—"Poisonous and Harmful Fishes," by G. P. Whitley, F.R.Z.S.

Bulletin No. 160.—"The Outbreak of the Australian Plague Locust (*Chortoicetes terminifera* Walk.) in the Season 1939-40, with Special Reference to the Influence of Climatic Factors," by K. H. L. Key, M.Sc., Ph.D.

Bulletin No. .—"The Soil and Land-Use Survey of the Wakool Irrigation District, New South Wales," by Robert Smith, B.Sc. (Agric.), R. I. Herriot, B.Ag.Sc., and E. J. Johnston, B.Sc.Agr.

Bulletin No. .—"Transmission of Potato Virus Diseases. 1.—Field Experiment with Leaf Roll at Canberra, 1940-41," by J. G. Bald, M.Agr.Sc., Ph.D., and D. O. Norris, B.Sc. (Agric.). "2.—The Aphis Population of Potatoes at Canberra during 1940-41," by D. O. Norris, B.Sc. (Agric.), and J. G. Bald, M.Agr.Sc., Ph.D.

PLATE 1.

Technique for Harvesting Seed of *Paspalum scrobiculatum*.
(See page 5.)

Original vacuum seed harvesting machine, at Lawes. Built by P. Jahn, Glenore Grove, Q. A, Blower; B, Collecting trough; C, Carburettor air-intake filter.

PLATE 2.

Technique for Harvesting Seed of *Paspalum scrobiculatum.*
(See page 5.)

Improved Machine ("Seed Gleaning Machine"). Lawes, 1942. Built by Becker's Motors, Toowoomba. A, Blower (driven by twin V-belts); B, Cyclone chamber; C, Grader; D, Seed bin; E, Air filter (Carburettor air-intake and oil filling plug both have filters attached). *Note:* Dust mask worn by operator.

PLATE 3.

Technique for Harvesting Seed of *Paspalum scrobiculatum.* (See page 5.)

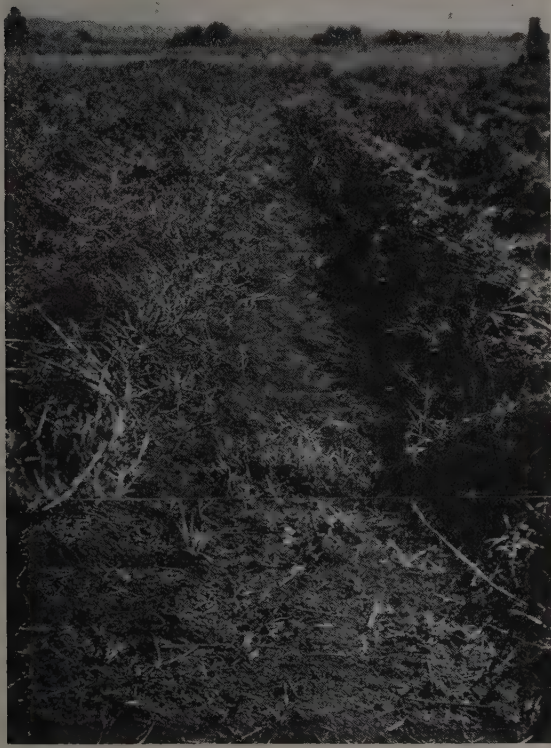


FIG. 1.—Composite photograph, showing inter-row space, before and after harvesting.

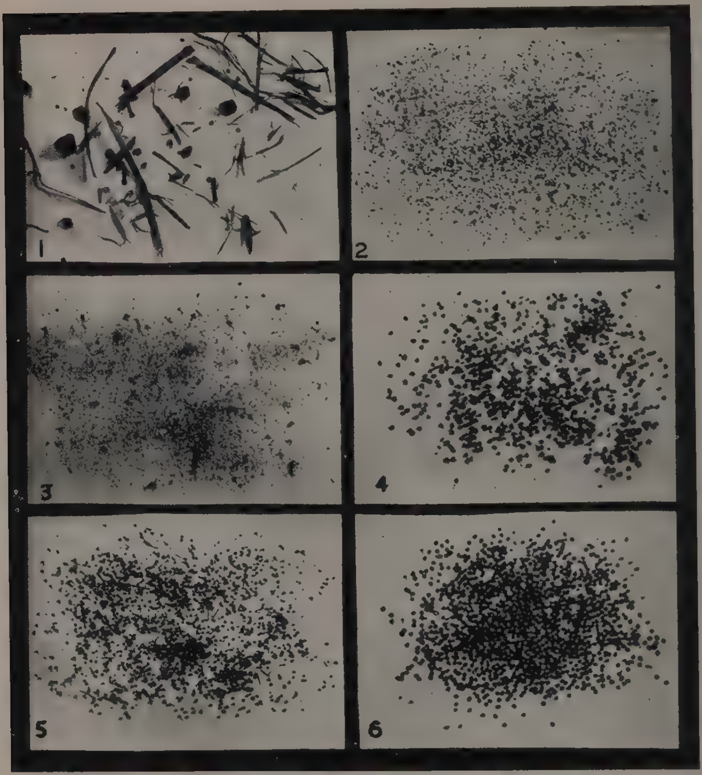
Foreground shows seed and debris lying on ground. Middle-distance shows inter-row space after harvesting.

FIG. 2.—Rotary seed grader, used for preliminary cleaning of material harvested.

PLATE 4.

Technique for Harvesting Seed of *Paspalum scrobiculatum*.

(See page 5.)



ANALYSIS OF BULK MATERIAL COLLECTED BY VACUUM HARVESTER.
JULY, 1942.

SAMPLE No. 1.—(Approx. 9%.)

Coarse matter; grass leaves, straw and larger dirt particles, etc.: removed by rotary grader.

SAMPLE No. 2.—(Approx. 18%.)

Soil and fine debris: expelled through openings in drum of Oat Clipper.

SAMPLE No. 3.—(Approx. 42%.)

Fine dust and lighter debris: drawn off by aspirator, attached to Oat Clipper.

SAMPLE No. 4.—(Approx. 3%.)

Larger particles: passed over upper sieve of Winnower (No. 6 sieve,* $^3/_{32}$ inch holes). This sample contains an appreciable amount of good seed.

SAMPLE No. 5.—(Approx. 18%.)

Finer particles: passed through lower sieve of Winnower. (No. $^1/_{18}$ sieve,* $^1/_{18}$ inch holes.

SAMPLE No. 6.—(Approx. 10%.)

Cleaned seed.

* Sieve numbers are those for "Clipper Grain Seed and Bean Cleaners," manufactured by A. T. Ferrell, Saginaw, Michigan, U.S.A.

PLATE 5.

The Recovery of the Glucoside Aesculin from the Australian Native Plant *Bursaria spinosa.* (See page 11.)

Fig. 1.—Flowering spray of *Bursaria spinosa.*

Fig. 2.—A Panicle in flower (actual size).

PLATE 6.

The Recovery of the Glucoside Aesculin from the Australian Native Plant *Bursaria spinosa*. (See page 11.)

FIG. 1.—Pressed specimen of *Bursaria spinosa*, showing the leaves, mature seed pods, and flower buds (actual size).

FIG. 2.—The mature seed pods. (× 4.)

PLATE 7.

Note on the Mapping of Soil Erosion. (See page 33.)

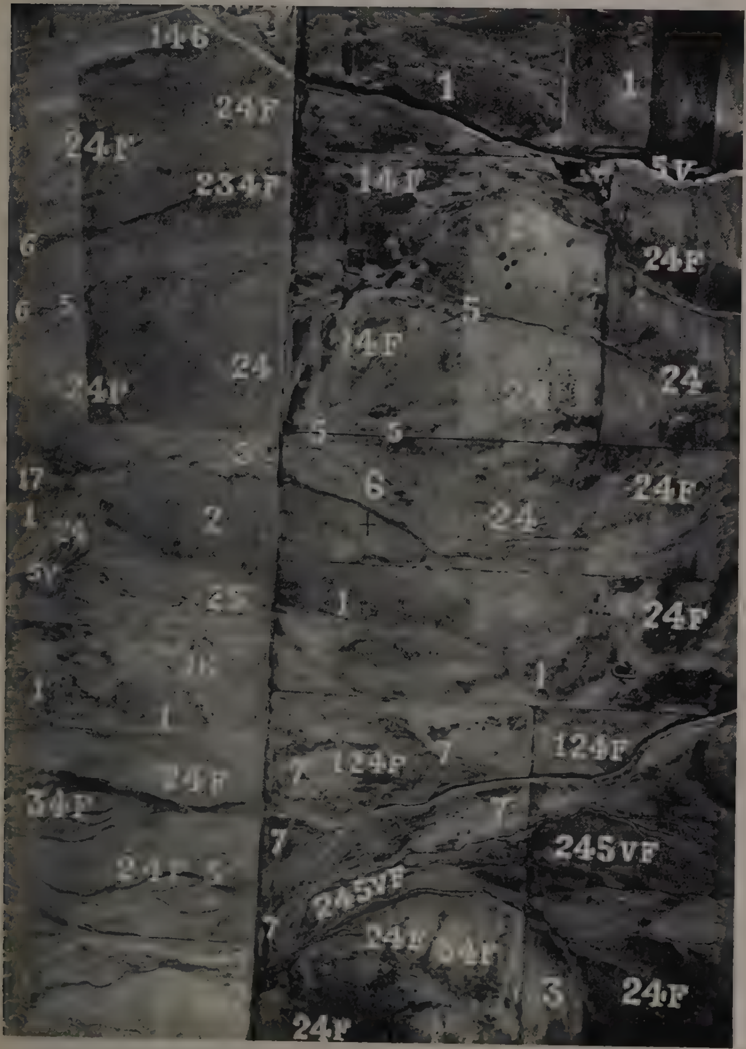


Fig. 1.—Aerial photograph in County Victoria, South Australia, covering approximately 3½ square miles and showing erosion pattern and mapping symbols used in the field designation (see Table 1).

Key 1 = Slight sheet erosion; 2 = moderate sheet erosion; 3 = severe sheet erosion; 4 = occasional shallow gutters; 4F = frequent gutters; 5 = occasional gullies; 5F = frequent gullies; 5V = deep gullies; 6 = slight deposition; 7 = damaging deposition.

H. E. Daw,
Govt. Printer, Melbourne.

(Supplement to the Journal of the Council for Scientific and Industrial Research, February, 1943.)

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[Supplement to the Journal of the Council for Scientific and Industrial Research, February, 1943.]

COMMONWEALTH OF AUSTRALIA

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ANNUAL REPORTS.

Nos. 1 to 15 inclusive. For years 1926-27 and 1940-41 respectively.

BULLETINS.

1. The Cattle Tick in Australia. (Out of print. See No. 13.)
2. Worm Nodules in Cattle. (Out of print.)
3. The Alunite Deposits of Australia and Their Utilization. (Out of print.)
4. The Factors Influencing Gold Deposition in the Bendigo Goldfield. Part I. (Out of print.)
5. Wheat-Storage Problems (Damaged Grain and Insect Pests). (Out of print.)
6. Power-Alcohol: Proposals for its Production and Utilization in Australia. (Out of print.)
7. Agricultural Research in Australia. (Out of print.) (The individual papers contained in this Bulletin can be supplied separately.)
8. The Factors Influencing Gold Deposition in the Bendigo Goldfield. Part. II. (Out of print.)
9. The Manufacture and Uses of Ferro-alloys and Alloy Steels. (Out of print.)
10. Substitutes for Tin-plate Containers. (Out of print.)
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13. The Cattle Tick Pest in Australia. (Out of print.)
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25. The Manufacture of Pulp and Paper from Australian Hardwoods. (Out of print.)
26. A Classification and Detailed Description of the More Important Wheats of Australia (a revision and extension of No. 18). (Out of print.)
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36. Kimberley Horse Disease.
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39. The Utilization of Sulphur by Animals, with special reference to Wool Production.
40. Observations on the Hydatid Parasite (*Echinococcus granulosus*) and the Control of Hydatid Disease in Australia.
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43. The Bionomics of *Fasciola hepatica* in New South Wales and of the Intermediate Host, *Limnea brazieri* (Smith).
44. Investigations on " Spotted Wilt " of Tomatoes.
45. A Soil Survey of the Woorinen Settlement, Swan Hill Irrigation District, Victoria.
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49. Factors affecting the Mineral Content of Pastures.
50. The Poisonous Action of Ingested Saponins.
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54. Investigations on " Spotted Wilt " of Tomatoes.—II.
55. The Basal (Standard) Metabolism of the Australian Merino Sheep.
56. A Soil Survey of Blocks A, B, C, D, and F, Renmark Irrigation District, South Australia.
57. Infectious Entero-toxaemia (the so-called Braxy-like Disease) of Sheep in Western Australia.
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60. Radio Research Board: Report No. 3.
61. Studies in the Supplementary Feeding of Merino Sheep for Wool Production.—I.
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88. Radio Research Board: Report No. 7.
89. Radio Research Board: Report No. 8.
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131. Black End and Anthracnose of the Banana with Special Reference to *Gloeosporium musarum* Cke. and Mass.
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133. A Soil Survey of the Mildura Irrigation Settlement, Victoria.

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Pamphlets.

1. Recent Developments in the Organization of National Industrial Research Institutions (1918). (Out of print.)
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4. The Bionomics of *Smynthurus viridis* Linn., or the South Australian Lucerne Flea.
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29. The Possibility of the Entomological Control of St. John's Wort in Australia.—Progress Report.
30. The Bionomics and Economic Importance of *Thrips imaginis* Bagnall.
31. A Preliminary Report on Investigations on the Buffalo Fly (*Lyperosia exigua* de Meij.) and its Parasites in Java and Northern Australia.
32. The Chemistry of Australian Timbers. Part 2.—The Chemical Composition of the Woods of the Ironbark Group.
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